Fishery Data Series No. 14-14

Evaluation of Stocked Rainbow Trout Populations in Interior Alaska, 2008–2010

By

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March 2014

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

Stocked rainbow trout *Oncorhynchus mykiss* populations in 31 lakes in the Tanana River and Upper Copper River drainages were evaluated during 2008–2010. We used two sampling schemes to provide managers with information about population length-age structure to determine if stocked fisheries were meeting management criteria and to provide basic population information to evaluate the presence of stocked fish in their expected size range. We also visually examined all captured fish for external signs of disease, parasites, and body condition (robust or thin).

We compared populations in 19 lakes to management criteria for mean length and relative abundance for predetermined length categories and expected age cohorts. The criteria that these fish populations had to meet or exceed were developed using a general population model based on age-specific mean lengths and survival rates. For predetermined length categories, eight rainbow trout populations did not meet management criteria for mean length, and the relative abundances for 15 populations were different from expected values. We were able to identify age cohorts in 15 populations. The mean length for at least one age cohort in each of 13 populations was smaller than expected. The relative abundance within identified age cohorts was evaluated for nine populations and all were different from management criteria.

We also collected basic information including presence/absence, size range, overall appearance, condition, and winter survival on fish populations in 12 lakes. Stocked fish were captured in five lakes, native species were observed in six lakes, and four lakes contained no native species or fish from previous stockings. Based on our findings we recommended adjustments to current stocking schemes with the purpose of eventually achieving the expected population criteria. We also recommended that four lakes be removed from the stocked fisheries program.

Key words: fish population monitoring, rainbow trout, *Oncorhynchus mykiss*, Craig Lake, Dick's Pond, Ken's Pond, Monte Lake, Coal Mine #5 Lake, Doc Lake, Fourteen Mile Lake, Ghost Lake, Hidden Lake (Tok), Meadows Road #1, Meadows Road #2, Meadows Road #3, Meadows Road #4, Meadows Road #5, Meadows Road #6, Nickel Lake, Rockhound Lake, Weasel Lake, Bluff Cabin Lake, Rapids Lake, Robertson #2 Lake, Olnes Pond, Lost Lake, North Chena Pond, Summit Lake, Kathleen Lake, Strelna Lake, Tolsona Lake, Crater Lake, Dick Lake, Tex Smith Lake, population structure, stocking evaluation, stock assessment, stocking method, stocking strategy, length-at-age, regional management objective.

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) stocks game fish in 132 lakes in the Tanana River drainage in Interior Alaska and the Upper Copper/Upper Susitna (UCUS) river drainages in the Glennallen area (Figure 1). The goal of the stocking program is to provide diverse and dependable angling opportunities near population centers and offer alternatives to the harvest of wild fish stocks. The stocking program began in the early 1950s, when lakes along the road system were stocked with rainbow trout *Oncorhynchus mykiss*, or coho salmon *Oncorhynchus kisutch*. Today, the stocking program provides year-round sport-fishing opportunity for rainbow trout, coho salmon, Chinook salmon *Oncorhynchus tshawytscha*, Arctic grayling *Thymallus arcticus*, and Arctic char *Salvelinus alpinus*.

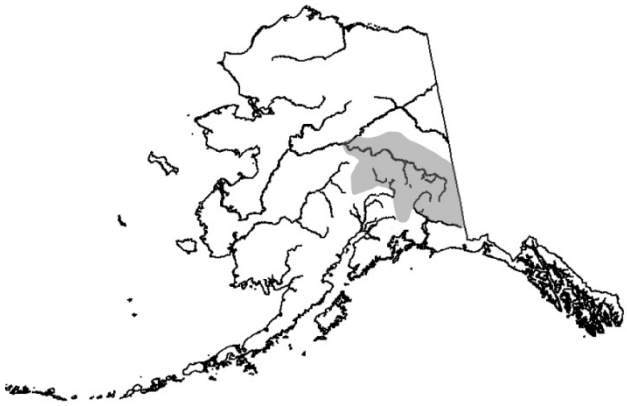

Figure 1.–The Tanana River and Upper Copper/Upper Susitna River drainages (shaded area).

The stocking program has multiple roles and provides many benefits. The program supports consumptive fisheries and creates new angling opportunities along the road system where potential fishing effort is greatest. It also supports rural and remote fisheries that are typically less crowded and have fish population structures with a greater proportion of large fish. As a conservation tool, it serves to divert fishing effort away from wild populations that cannot support the harvest desired by anglers. Anglers and businesses in the Tanana Valley value the stocking program because it provides angling opportunities that normally would not be present and it benefits local economies through the sales of fishing related sporting goods and guiding services. Anglers particularly enjoy opportunities to catch highly desired species such as rainbow trout and Arctic char which are not native to the Tanana Valley.

STOCKED WATERS MANAGEMENT PLAN

In 2004, the Alaska Board of Fisheries (BOF) adopted two new general management plans for the stocked waters fisheries within Region III (5 AAC 70.065 and 5 AAC 52.065; 2004). The management plans state: "The department shall manage stocked waters in the Arctic-Yukon-Kuskokwim Region (and the Upper Copper River and Upper Susitna River Area) in order to meet public demand for diverse fishing opportunities." The plans outline three management approaches (regional, conservative, and special) and corresponding objectives and regulations for each.

- Regional Management Approach. Stocked waters will be managed for a reasonable expectation of high catch rates and harvesting a daily bag limit. The bag and possession limit is 10 fish in combination of all stocked species, and only one of those fish may be 18 inches (457 mm TL) or greater in length. The fishing season is open year round and bait may be used.
- Conservative Management Approach. Stocked waters will be managed for a reasonable expectation to catch a daily bag limit with a reasonable chance of catching fish 18 inches (457 mm TL) or greater in length. The bag and possession limit is five fish in combination of all stocked species, and only one of those fish may be 18 inches (457 mm TL) or greater in length. The fishing season is open year round and bait may be used.

- Special Management Approach. Stocked waters will be managed for a high probability of an angler catching more than one fish a day that is 18 inches (457 mm TL) or greater in length. When considering a proposal regarding this management approach, the board should consider taking the following actions:

    (1) limit fishing;

        a) catch-and-release fishing;

        b) fly fishing;

        c) trophy fishing, which means that a fish retained must be 18 inches (457 mm TL) or greater in length;

    (2) establish seasonal periods when fishing is closed or is restricted to catch-and-release fishing; or,

    (3) establish a bag limit of one fish, 18 inches (457 mm TL) or greater in length, or another appropriate bag and size (length) limit.

STOCKED WATERS PROGRAM ASSESSMENT

ADF&G will need to focus on anglers in the future to directly assess their understanding of the three management approaches, their expectations, and whether their expectations are being met. However, ADF&G is currently stocking fish that are less than desirable and fishery managers must deal with numbers of fish, sizes, and production schedules that don't meet angler needs. Any direct evaluation of our success in meeting management objectives should be suspended until 2014 when fish production from the new Ruth Burnett Sport Fish Hatchery in Fairbanks and the stocked fish populations have stabilized. Any efforts to directly survey anglers now will only serve to evaluate a changing interim condition. But it is prudent to begin planning such a survey now.

In the future, as hatchery production improves, a scientific survey of anglers will provide information needed by managers to directly assess the stocking program. For now, defining and using population structure as the objective for each of the three management approaches is an indirect but reasonable approach to assess the stocking program.

POPULATION STRUCTURE AND STOCKING STRATEGY

Each management approach lists general objectives for catch rates and sizes of fish that anglers should have a reasonable expectation to catch and harvest. To meet these objectives we designed a general "expected" population structure for each management approach that would provide a reasonable opportunity for an angler to catch and harvest the numbers and sizes of fish described in each approach.

To determine what size fish would meet anglers' expectations we conducted informal interviews with anglers and biologists. General agreement was that most anglers would be "satisfied" catching a rainbow trout that was at least 250 mm (FL) and the minimum length for a "quality" fish was 460 mm (FL). All lengths listed in the remainder of this report are fork length (FL) unless otherwise specified.

To support the Regional Management approach with a high catch rate and liberal bag limit a population structure was designed to emphasize large numbers of fish from 200 mm to 350 mm.

Populations for the Conservative and Special Management approaches were designed to emphasize fish larger than 350 mm. Compared to the Regional Management approach there are fewer fish in these populations and harvest is more restrictive. The goal for the Conservative and Special Management approaches was to provide a greater proportion of large or "quality" fish in the population with the largest fish in lakes under Special Management.

A model was used to generate the abundances and length distributions for the various age cohorts that made up a population structure. The abundance and length distribution for an age cohort were calculated using generalized values for survival rate-at-age and length-at-age which were obtained from a review of the literature, past experience, and results from recent population studies. Survival rate-at-age and length-at-age were specific to each management approach (Table 1). Sampling events were conducted in spring or fall and length-at-age was adjusted to account for size difference due to growth. The population model and the parameters used to generate it are described by Skaugstad (*in prep*).

Table 1.–Generalized survival rate-at-age and length-at-age for Regional, Conservative, and Special management approaches. Values for length-at-age are specific to fall.

Approach	Age 1	Age 2	Age 3	Age 4	Age 5
Regional					
Survival	0.10	0.40	0.40	0.20	0.10
Length (mm)	210	300	370	410	450
Conservative					
Survival	0.10	0.50	0.50	0.40	0.40
Length (mm)	230	320	390	440	480
Special					
Survival	0.10	0.60	0.60	0.50	0.40
Length (mm)	250	340	410	460	500

A stocking strategy was then developed for each fishery that would produce the desired population structure. The stocking strategy had goals for the size (length or weight) and number of fish to stock, number of stockings each year, time of year, and whether stockings were annual or biennial. These strategies were then used to determine production schedules for the ADF&G fish hatcheries.

FISHERY SPECIFIC MANAGEMENT CRITERIA

The population structures that we designed for each fishery were used to calculate quantitative criteria for measuring the success of the stocking program. The successful creation and maintenance of a population structure that met or exceeded the criteria was used as a surrogate to indicate that we successfully met the objectives for the appropriate management approach.

We compared statistics for the sampled population to criteria that we established for mean length and relative abundance for predetermined length categories and age cohorts. The length categories for the Regional Management approach were <250 mm and ≥250 mm. The length categories for the Conservative and Special Management approaches were <460 mm and ≥460 mm along with secondary length categories of <250 mm and ≥250 mm. Mean length and relative abundance for fish in each size category were calculated using the population length-age structures defined for each fishery. Mean length and relative abundance was also calculated for each age group.

POPULATION SAMPLING

Fish populations in 31 lakes were selected for sampling in 2008–2010 (Table 2; Figures 2, 3, and 4). Fishery managers needed information about the population length-age structure for rainbow trout populations in 18 lakes to determine if current stocking strategies created the desired population structures. In the other 13 lakes managers were only interested in basic information to determine if stocked fish were present, to visually assess their body condition (robustness) and health, or to make a crude estimate of their length distribution. A less-than-normal body condition is a quick but subjective indicator that some undetermined factor is adversely affecting individual fish. Summary information about all sampled populations was made available to anglers.

If 15 or more rainbow trout were captured during sampling for basic population information a length-age structure analysis was performed. Similarly, if fewer than 15 rainbow trout were captured while sampling for length-age analysis, only basic population information was summarized.

When we sample fish populations we usually collect water temperature and dissolved oxygen (D.O.) data at predetermined depths (Mansfield and Behr 2011). These data are also collected by other researchers at other times and various locations. All data are archived in a Water Quality database at Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska.

Table 2.-Description of fisheries sampled in 2008–2010.

Year Sampled	Fishery	Hectare (Acre)	Management Category	Stocking Frequency	Information Needed
Tanana Management Area – Delta subarea					
2008, 2010	Craig Lake	6.9 (17)	Regional	alternate	length-age
2008	Dick's Pond	2.0 (5)	Regional	alternate	basic
2008	Ken's Pond	2.0 (5)	Regional	alternate	length-age
2008	Monte Lake	36.4 (90)	Special	alternate	length-age
2009	Coal Mine #5 Lake	5.3 (13)	Regional	alternate	length-age
2009	Doc Lake	1.2 (3)	Regional	alternate	length-age
2009	Fourteen Mile Lake	36.4 (90)	Regional	alternate	basic
2009	Ghost Lake	3.6 (9)	Regional	alternate	length-age
2009	Hidden Lake (Tok)	10.5 (26)	Regional	alternate	length-age
2009	Meadows Road #1	0.8 (2)	Regional	alternate	basic
2009	Meadows Road #2	2.6 (6.6)	Regional	alternate	basic
2009	Meadows Road #3	1.2 (3)	Regional	alternate	basic
2009	Meadows Road #4	1.6 (4)	Regional	alternate	basic
2009	Meadows Road #5	1.0 (2.5)	Regional	alternate	basic
2009	Meadows Road #6	2.0 (5)	Regional	alternate	basic
2009	Nickel Lake	2.0 (5)	Regional	alternate	length-age
2009	Rockhound Lake	1.0 (2.5)	Regional	alternate	length-age
2009	Weasel Lake	3.2 (8)	Regional	alternate	basic
2010	Bluff Cabin Lake	29 (72)	Regional	alternate	length-age
2010	Rapids Lake	2.7 (6.6)	Regional	alternate	length-age
2010	Robertson #2 Lake	6.1 (15)	Regional	alternate	length-age
Tanana Management Area – Fairbanks subarea					
2009	Olnes Pond	2.0 (5)	Regional	alternate	basic
2010	Lost Lake	38 (94)	Regional	annual	length-age
2010	North Chena Pond	2.0 (5)	Regional	annual	basic
2010	Summit Lake	182 (450)	Special	alternate	basic
Upper Copper / Upper Susitna River Management Area					
2009	Kathleen Lake	8.1 (20)	Regional	alternate	length-age
2009	Strelna Lake	117 (290)	Regional	alternate	length-age
2009	Tolsona Lake	125 (309)	Regional	alternate	length-age
2010	Crater Lake	6.5 (16)	Regional	alternate	length-age
2010	Dick Lake	16.2 (40)	Regional	alternate	basic
2010	Tex Smith Lake	6.1 (15)	Regional	alternate	length-age

Note: Fish stocking records for the six years prior to sampling for each lake are summarized in Appendix A.

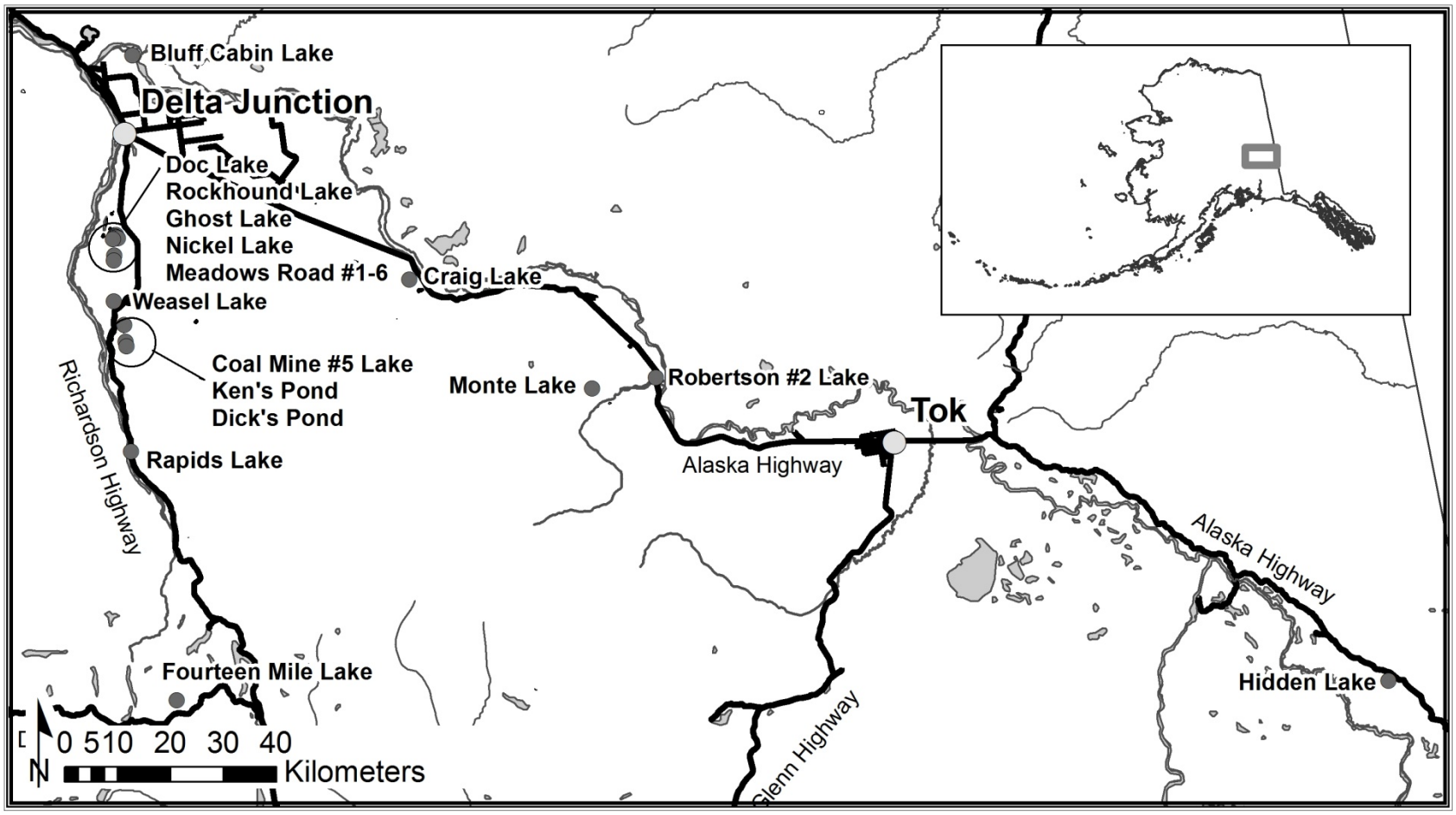

Figure 2.-Upper Tanana Management Area (Delta) lakes where stocked fish populations were sampled in 2008–2010.

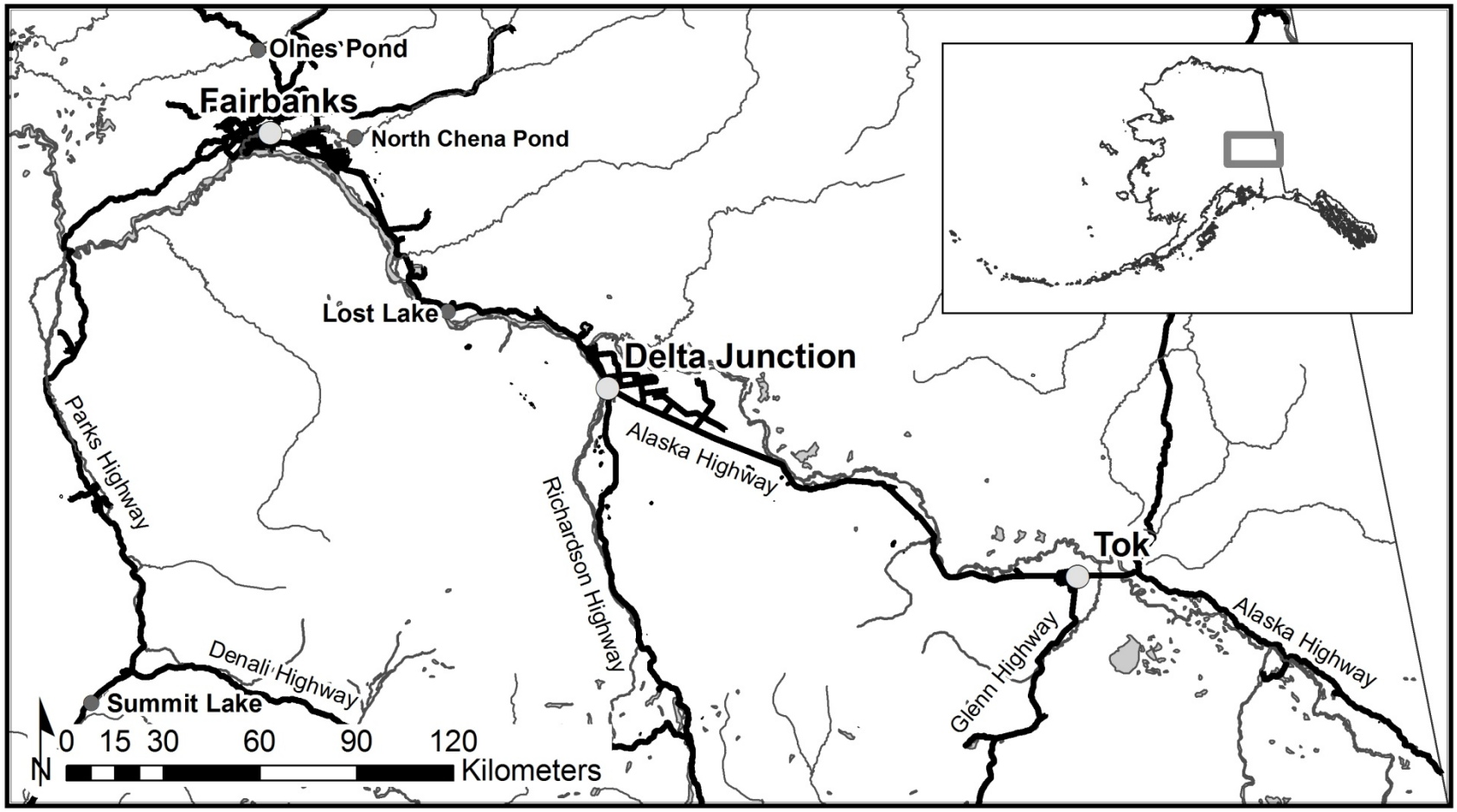

Figure 3.-Lower Tanana Management Area (Fairbanks) lakes where stocked fish populations were sampled in 2008–2010.

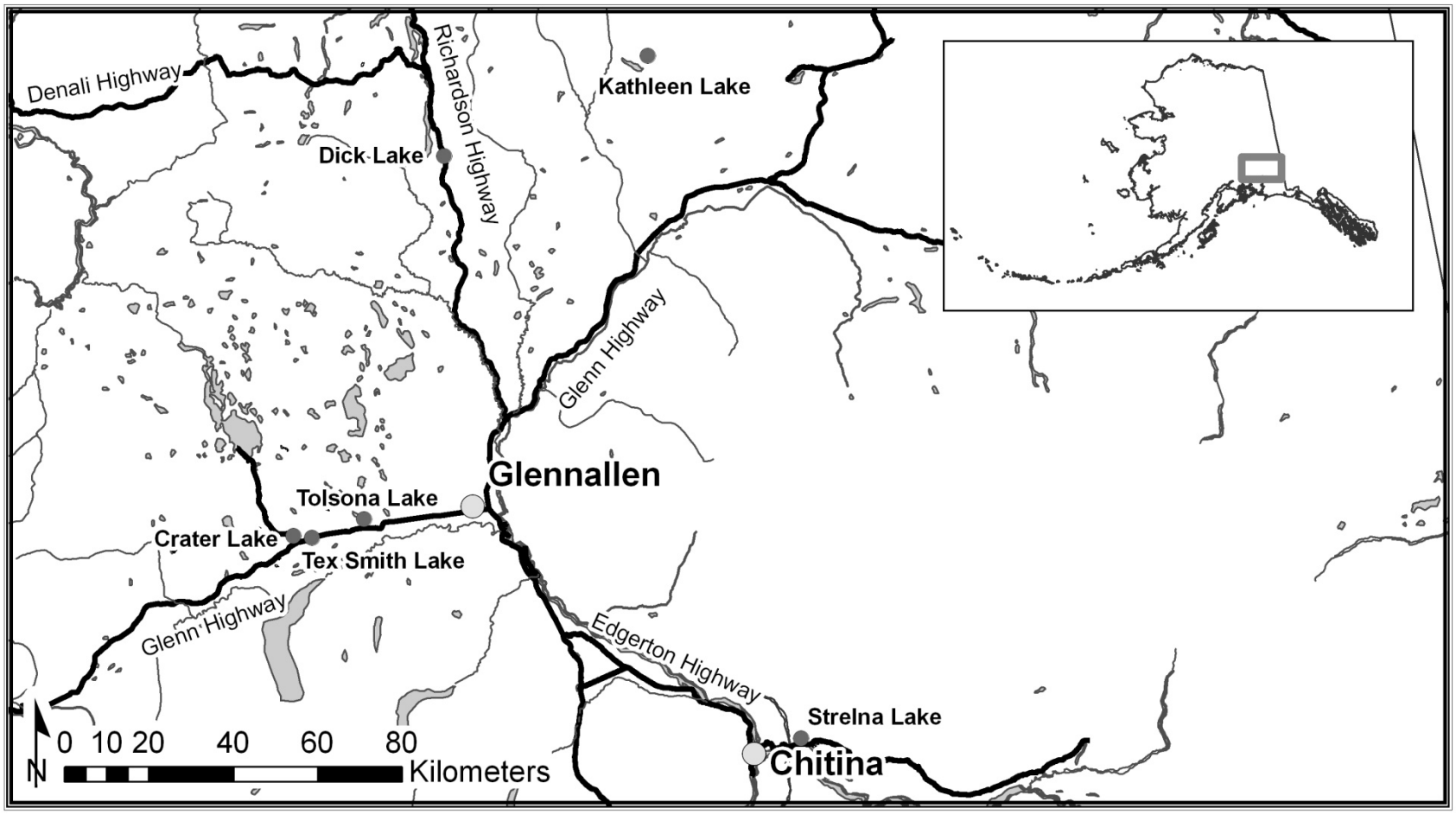

Figure 4.-Upper Copper Upper Susitna Management Area (Glennallen) lakes where stocked fish populations were sampled in 2008–2010.

SAMPLING FOR POPULATION LENGTH-AGE STRUCTURE

During 2008–2010 staff from the Stocked Fisheries Program sampled 18 lakes to obtain population length-age information. Unless described otherwise, all trails are accessible by foot, ATV, or snow machine.

Tanana Management Area

Craig Lake is approximately 2.4 km west of the Alaska Highway at Mile 1,383.7 (Upper Tanana Management Area; Figure 2) Access is along a trail. Surface area is 6.9 ha and maximum depth is 23 m. The lake was first stocked with rainbow trout fingerlings in 1960. ADF&G stocked coho salmon, rainbow trout, Arctic grayling, sheefish *Stenodus leucichthys*, and lake trout *Salvelinus namaycush* intermittently from 1960 through the early 1990s. Currently, rainbow trout fingerlings are stocked on even years. Fish captured during spring 2008 sampling were stocked as fingerlings in 2003, 2004, or 2006. Fish captured during fall 2010 sampling were stocked as fingerlings in 2006 or 2008.

Ken's Pond is near Dick's Pond, at 7.6 km Coal Mine Road, 42 km south of Delta Junction (Upper Tanana Management Area; Figure 2). Access is along a trail. Surface area is 2.0 ha and maximum depth is 6.5 m. The lake was first stocked with rainbow trout fingerlings in 1987. Currently, ADF&G stocks Arctic char and rainbow trout fingerlings on alternate years. Rainbow trout captured during spring 2008 sampling were stocked as fingerlings in 2004 or 2006 and Arctic char were stocked as subcatchables in 2004, 2005, or 2007.

Monte Lake is approximately 3 km north of the Robertson River and 12.6 km east of the Alaska Highway at km 2,170.7 (Upper Tanana Management Area; Figure 2). Access is by aircraft or along an undefined trail but during summer trail access is difficult. Surface area is 36.4 ha and maximum depth is approximately 32 m. It is remote and has a wild population of lake trout. Rainbow trout have been stocked since 1982. Currently, rainbow trout fingerlings are stocked on even years. Fish captured during spring 2008 sampling were stocked as fingerlings in 2004 or 2006.

Coal Mine #5 Lake is approximately 2.4 km from the Coal Mine Road parking area, 42 km south of Delta Junction (Upper Tanana Management Area; Figure 2). Access is by trail. Surface area is 5.3 ha and maximum depth is approximately 8 m. The lake was first stocked with rainbow trout in 1989. Arctic char, lake trout, and coho salmon were also stocked in the 1980s and 1990s. Currently, rainbow trout fingerlings are stocked on even years. Fish captured during spring 2009 were stocked in 2004, 2006, or 2008.

Doc Lake is north of No Mercy and Rockhound lakes, approximately 1.4 km from the Twin Lakes parking area on Meadows Road, 13.5 km south of Delta Junction (Upper Tanana Management Area; Figure 2). Access is by trail. Surface area is 1.2 ha and maximum depth is 8 m. The lake was first stocked with rainbow trout in 1973. Chinook salmon, coho salmon, and Arctic char were also stocked in the 1970s and 1980s. Currently, rainbow trout fingerlings are stocked on even years. Fish captured during spring 2009 sampling were stocked in 2004, 2006, or 2008.

Ghost Lake is north of Windy Ridge Road at kilometer 17.2 from Meadows Road junction with the Richardson Highway, at the end of a 0.6 km trail (Upper Tanana Management Area; Figure 2). Access is by trail from Windy Ridge Road. Surface area is 3.6 ha and maximum depth is 12 m. The lake was first stocked with rainbow trout in 1987. Currently, rainbow trout and

Arctic char fingerlings are stocked on even years. Rainbow trout captured during spring 2009 sampling were stocked in 2004, 2006, or 2008. Lake trout were also intermittently stocked into this lake from 1988 to 2000 and may still be present.

Hidden Lake (Tok) is within the Tetlin National Wildlife Refuge approximately 38 km southeast of Northway Junction on the Alaska Highway at kilometer 1,990.8 (Upper Tanana Management Area; Figure 2). Access is by a 1.6 km trail. Surface area is 10.5 ha and maximum depth is approximately 9 m. Hidden Lake has been stocked with rainbow trout since 1982 and is currently stocked with rainbow trout fingerlings on odd years. Fish captured during fall 2009 sampling were stocked in 2007.

Nickel Lake is south of Ghost Lake on the south side of Windy Ridge Road at kilometer 17 from Meadows Road junction on the Richardson Highway (Upper Tanana Management Area; Figure 2). Access is by road. Surface area is 2.0 ha and maximum depth is approximately 11 m. The lake was first stocked with rainbow trout in 1986. Currently Arctic char, Arctic grayling, and rainbow trout are stocked on even years. Rainbow trout captured during spring 2009 sampling were stocked in 2004, 2006, or 2008.

Rockhound Lake is east of No Mercy Lake, approximately 0.8 km from the Twin Lakes parking area on Meadows Road, 13.4 km south of Delta Junction (Upper Tanana Management Area; Figure 2). Access is by trail. Surface area is 1 ha and maximum depth is approximately 10 m. The lake was first stocked with rainbow trout in 1973. Lake trout were stocked in the late 1980s and today rainbow trout fingerlings are stocked on even years. Rainbow trout captured during fall 2009 sampling were stocked in 2004, 2006, or 2008.

Bluff Cabin Lake is approximately 8.5 km southeast of Quartz Lake, and 26 km North of Delta Junction (Upper Tanana Management Area; Figure 2). Access is by a 5.6 km trail that begins from the Tanana Loop Extension and extends north to the lake. Surface area is 29 ha and maximum depth is approximately 7 m. The lake was first stocked with rainbow trout fingerlings in 1980. Rainbow trout fingerlings are stocked on even years. Fish captured during fall 2010 sampling were stocked in 2004, 2006, or 2008.

Rapids Lake is east of the Richardson Highway at kilometer 362.7, approximately 65 km south of Delta Junction (Upper Tanana Management Area; Figure 2). The lake is east of the Alyeska Pipeline and can be accessed along a 50 m trail. Surface area is 2.7 ha and maximum is approximately 6 m. The lake was first stocked with rainbow trout fingerlings in 1962. Coho salmon fingerlings were stocked in 1973 and lake trout subcatchables were stocked throughout the 1990s. Today the lake is stocked with rainbow trout fingerlings on even years. Rainbow trout captured during fall 2010 sampling were stocked in 2004, 2006, or 2008. Lake trout captured were from stockings conducted in the 1990s and potentially from natural reproduction.

Robertson #2 Lake is west of the Alaska Highway at kilometer 2169, 116 km southeast of Delta Junction (Upper Tanana Management Area; Figure 2). Access is along a 0.4 km trail from the old Haines Pipeline just south of the Robertson River Bridge. Surface area is 6.1 ha and maximum depth is approximately 5 m. The lake was first stocked with rainbow trout fingerlings in 1971. Rainbow trout fingerlings are now stocked on even years. Fish stocked in 2004, 2006, or 2008 should have been present during fall 2010 sampling.

Lost Lake is approximately 90 km southeast of Fairbanks and south of Birch Lake and the Richardson Highway at kilometer 492.7 (Lower Tanana Management Area; Figure 3). Surface

area is 15.78 ha and maximum depth is approximately 20 m. It was first stocked in 1952 with rainbow trout fry from the Birch Lake Hatchery and has also been stocked with coho salmon, Arctic grayling, sheefish, Arctic char, lake trout, and Chinook salmon. Currently, the lake is stocked annually with Arctic char and rainbow trout fingerlings, and occasionally with Arctic grayling fingerlings and rainbow trout broodstock. Most rainbow trout captured during 2010 sampling were stocked in 2009.

Upper Copper / Upper Susitna River Management Area

Kathleen Lake is northeast of Mankomen Lake, at the end of an 8.85 km trail (Upper Copper/Upper Susitna River Management Area; Figure 4). Surface area is 8.1 ha and maximum depth is approximately 5 m. Kathleen Lake is too small for aircraft to land but Mankomen Lake is accessible by float plane and there are private airstrips nearby. Kathleen Lake was stocked once in 2007 with rainbow trout fingerlings. Rainbow trout captured during spring 2009 sampling were from this stocking.

Strelna Lake is 17 km east of Chitina along the McCarthy Road. Public access is by foot only along a steep 0.5 km trail extending north from McCarthy Road (Upper Copper/Upper Susitna River Management Area; Figure 4). Surface area is 117 ha and maximum depth is approximately 20 m. The lake was first stocked with rainbow trout in 1969. Currently, coho salmon are stocked on even years and rainbow trout on odd years; however, rainbow trout were removed from Summit Lake (Wrangles-St. Elias National Park) and released into Strelna Lake in 2008. Coho salmon were not stocked in 2006 due to reports of overstocking in previous years. Rainbow trout captured during fall 2009 sampling were stocked in 2003 or 2007 as fingerlings, or were Summit Lake fish stocked in 2008.

Tolsona Lake is approximately 28 km west of Glennallen and 1 km north of the Glenn Highway (Upper Copper/Upper Susitna River Management Area; Figure 4). Surface area is 125 ha and maximum depth is 5 m. The lake was first stocked with rainbow trout in 1982. Chinook salmon and Arctic grayling were stocked in the early 1990s and stockings were discontinued altogether in 1999 due to access and outlet issues. These issues were resolved and stockings were reinstated at the area manager's request in 2008. Rainbow trout fingerlings stocked in 2008 should have been present during fall 2009 sampling.

Crater Lake is located at kilometer 1.8 on Lake Louise Road, approximately 43 km west of Glennallen (Upper Copper/Upper Susitna River Management Area; Figure 4). The lake is located at the end of a steep trail approximately 160 m from the parking area. Surface area is 6.5 ha and maximum depth is approximately 5 m. Crater Lake was first stocked with rainbow trout in 1966 and has also been stocked with coho salmon and Arctic char. Currently, rainbow trout fingerlings are stocked on even years. Fish captured during fall 2010 sampling were stocked in 2004, 2006, or 2008.

Tex Smith Lake is north of the Glenn Highway at kilometer 261 (Upper Copper/Upper Susitna River Management Area; Figure 4). Surface area is 6.1 ha and maximum depth is approximately 6 m. The lake was first stocked with rainbow trout fingerlings in 1968. Coho salmon were stocked in 1975 and Arctic char fingerlings were stocked in 1994. Rainbow trout catchables are usually stocked into Tex Smith Lake annually; however, fingerlings are currently being stocked on odd years due to recent production limitations. Fish captured during spring 2010 sampling were stocked as fingerlings in 2007 or 2009 or as catchables in 2005 or 2006.

Objectives

Management Objective 1: Determine if stocked rainbow trout populations were achieving management criteria.

Research Objective 1: Test the null hypothesis that mean length of rainbow trout within defined length categories and age cohorts does not differ from the predicted value with 90% power of rejecting the null hypothesis if the true mean length differs from the predicted value by more than 10% using alpha = 0.10.

Research Objective 2: Test the null hypothesis that the proportion of rainbow trout within defined length categories and age cohorts does not differ from the predicted value with 80% power of rejecting the null hypothesis if the true proportion differs from the predicted value by more than 10 percentage points using alpha = 0.20.

Methods

Sampling Procedure

Fyke nets and tangle nets were used to capture fish. Fyke nets were set near shore on the lake bottom in 1 to 2 m of water. Fyke nets had openings that were either 0.9 or 1.2 m^2, the body length from opening to cod end was about 5 m, hoop size was 0.9 m diameter, and mesh size was 9 mm^2. Wings measuring 7.5 m long by 1.2 m deep were attached to each side of the open end. The net body was positioned parallel to shore and the wings set to form a "V." Each fyke net was pulled taut from the cod end and held in position with a weight.

Tangle nets were set perpendicular to shore in water deeper than 2 m. Tangle nets measured 45 m long by 5.4 m deep and were made of 13 mm bar fine thread monofilament. Mesh size was small to ensure that fish were captured by entanglement around the mouth and not by the gill covers. Two net types were used. One net was a "floater;" the float line buoyancy was greater than the weight of the lead line. The other net was a "sinker;" the lead line was weighted to overcome the buoyancy of the float line. The "floater" had a triple float line and 13.5 kg lead line. The "sinker" had a double float line and a 31.5 kg lead line. Generally, tangle nets were checked every 30 minutes. The field crew leader adjusted the time interval between net checks depending on an immediate assessment of the condition of the captured fish.

The amount of capture gear and the duration of sampling projects were based on lake size (Table 3). In larger lakes, more capture gear was used and the duration of the project was increased. Sampling was stopped at the end of the allotted time even when a sample size was not achieved.

Table 3.–Amount of capture gear and duration of sampling project by lake size.

Hectare (Acre)	Days	Fyke Nets	Tangle Nets	Hoop Traps
0 to 20 (50)	1	4	1	5
>20 to 40 (100)	2	4	1	5
>40 to 200 (500)	3	4	2	8
>200 to 400 (1,000)	3	6	2	10
>400 (1,000)	3	8	2	10

All captured fish were measured to the nearest mm FL. Fish captured for the first time regardless of gear type were marked by removing a half circle of tissue from the trailing edge of the upper lobe of the caudal fin. The mark was made with a paper punch that produced a 7 mm diameter circular hole. Subsequent recaptures were recorded but the data were not used for analysis.

The field crew monitored water temperature daily 1 m beneath the surface. We tried to conduct all fish sampling when water temperature was <18°C.

Data Reduction and Analysis

Sample data were used to enumerate rainbow trout within specific length categories and to generate length-frequency distributions (LFDs) for each rainbow trout population. When possible, age cohorts were identified by visual inspection of LFD plots and the corresponding mean lengths were calculated using the appropriate length data. LFD plots were generated for both stocked and wild species when 10 or more fish of the same species were captured.

The length or age composition of each rainbow trout population was calculated using (Cochran 1977):

$$\hat{p}_k = \frac{y_k}{n} \tag{1}$$

where:

$\hat{p}_k$ = the proportion (relative abundance) of rainbow trout that belong to length category or age cohort k;

y_k = the number of rainbow trout sampled that belong to length category or age cohort k; and,

n = the total number of rainbow trout sampled.

The unbiased variance of this proportion was estimated as:

$$\hat{V}(\hat{p}_k) = \frac{\hat{p}_k(1-\hat{p}_k)}{n-1} \tag{2}$$

Observed mean lengths and sampling variances within specific size categories and age cohorts were calculated using standard statistical methods (Cochran 1977).

For visual comparison, LFDs generated using sample data were plotted with the corresponding population curve that was generated from the management population structure. For each population the observed number of rainbow trout that belonged to a specific size category or age cohort was compared to the management criteria using χ^2 goodness of fit tests (Zar 1984). Observed mean lengths were compared to calculated mean lengths for management criteria for the same specific size category or age cohort using single-sample t-tests (Zar 1984). The χ^2 goodness of fit tests were evaluated using $\alpha = 0.20$ and the t-tests were evaluated using $\alpha = 0.10$.

If fewer than 15 fish were captured statistical tests were not performed. Preliminary power analysis indicated that this sample size was insufficient to achieve the desired precision criteria. Additionally, statistical tests performed with fewer than 15 fish were likely to produce inconclusive results for fish populations having multimodal distributions with different peak amplitudes.

Management criteria were considered achieved when the observed mean length or relative abundance was not statistically different from the criteria or, if statistically different, the difference was ≤ 0.10 for relative abundance or ≤ 25 mm for mean length. We considered these differences not meaningful to anglers. Management criteria were also considered achieved when the observed mean length was larger than the criteria regardless of statistical significance.

Assumptions and Bias

One potential concern with using data from this single-sample study design is that inadequate data are collected to evaluate size bias during sampling. An accurate estimate of a population LFD requires that all fish in a population have the same probability of capture. In practice this probably does not happen and this assumption cannot be evaluated with a single-sample capture-event. A comprehensive review of the literature and previous work by ADF&G, including an analysis of effect of bias for various scenarios related to this and similar studies, was presented by Skaugstad et al. (2010).

For our studies, the bias introduced by unequal capture probabilities for the different length-age cohorts have different effects on estimating length frequency mode location and mode amplitude. Mode location is important for determining the mean length of length-age cohorts while mode amplitude is important for determining the relative abundance of the length-age cohorts in the population. The bias caused by unequal capture probabilities when estimating mode location will be minimal when individuals in each length-age cohort have the same capture probability (i.e., capture probabilities are the same within cohorts but may be different between cohorts).

Bias will have a greater influence on estimating mode amplitude and, thus, on estimating proportions of fish in different length-age categories (i.e., relative abundance). Different capture probabilities between length-age cohorts will result in catches that are not representative of cohort abundance in the population. Increasing the sample size will make the modes more prominent but it will not improve the accuracy of the estimate. However, our review of other studies has shown that the likelihood of size bias is low when sampling is restricted to periods when water temperature is <18°C. It is anticipated that two-sample mark-recapture studies will be conducted periodically for the larger lakes which are stocked on an annual basis and support a number of age cohorts. We will continue to use information from these studies to evaluate potential size bias associated with single-capture sampling.

Results, Discussion, and Recommendations

In this section we present our data, observations, and describe our rational for making recommendations for the various stocked fisheries. We base our recommendations on the examination of population LFDs, the use of ancillary limnology information, and our experience to diagnose the likely cause underlying any differences between the observed and expected population LFDs. We then recommend suitable adjustments to the stocking scheme with the purpose of eventually achieving the expected population LFD.

Occasionally, we discover for some fisheries the desired population abundance or LFD is not achievable due to the natural limits of the system, the number of fish harvested is too high to be sustainable, or both. Depending on circumstances, we will recommend that a fishery be moved to a different management category, suggest an alternate species for stocking, or propose that a lake be removed from the stocked fisheries program.

Tanana Management Area

Craig Lake

The rainbow trout population was sampled during June 4–5, 2008. Water temperature 1 m beneath the surface ranged from 13.7 to 14.2°C. Thirteen rainbow trout (Figure 5) and 559 lake chub *Couesius plumbeus* were captured. All rainbow trout and 169 lake chub were measured (Figure 6). All fish were captured in fyke nets and appeared to be in good condition. No external signs of parasite or disease were observed. Too few rainbow trout were captured to perform statistical analysis; however, visual inspection of the observed LFD suggested that fish <250 mm were likely age 2. This age cohort appeared slightly smaller than the expected management population structure (Figure 5).

The population was sampled again during August 11–12, 2010. Maximum water temperature 1 m beneath the surface was 17.9°C. Nineteen rainbow trout (Figure 7) and 765 lake chub (Figure 8) were captured. All rainbow trout and 20 lake chub were measured. Fish were captured in both fyke nets and tangle nets. Rainbow trout appeared to be in good condition but many of the lake chub had distended bellies containing large tape worms that resembled *Schistocephalus* sp. One lake chub measuring approximately 110 mm contained a tape worm that was over 200 mm in length.

Captured fish <250 mm were not statistically different from management criteria (Table 4), but only eight fish were captured in this length category. Examination of the observed LFD indicated that all rainbow trout captured during 2010 sampling were likely age 2. Age-2 fish were significantly smaller than expected (Table 5), and the difference was > 25 mm. Management criteria for rainbow trout in Craig Lake were not met.

Satisfactory D.O. concentrations have been observed throughout most of the water column during both winter and summer (8.2 mg•L^{-1} 1 m beneath the surface and 3.9 mg•L^{-1} at the bottom in March 2000; and 9.5 mg•L^{-1} at the surface and 1.7 mg•L^{-1} at the bottom in July 2008). Similarly, sufficient thermal refuge appeared to be present during July 2008, when nearly 80% of the water column was less than 10°C.

We caught fewer fish than expected because anglers may have harvested more fish than expected. Age-4 rainbow trout were missing from our sample which suggests these fish were probably harvested. We've documented similar results at Lisa Lake where an older age cohort

disappeared between spring and fall sampling events (Behr et al. 2005). Craig Lake is reported annually in the Statewide Harvest Survey but catch and harvest could not be evaluated due to too few respondents.

Craig Lake has been stocked with lake trout and some could still be present. Anglers reported catching lake trout in the 2002 and 2008 Statewide Harvest Surveys but we captured none during 2008 or 2010 sampling. While predation of rainbow trout is possible it would not explain the smaller than expected size for rainbow trout. While predation would explain why there were fewer rainbow trout in the population, it would not explain the absence of older, larger fish.

Craig Lake is deeper than most other lakes that have similar small surface area. We observed abundant aquatic vegetation along the perimeter but the sides are steep a few meters from shore. While food and habitat are probably adequate to support a typical rainbow trout population (10 $kg \bullet ha^{-1}$) it is likely that lake chub are competing with rainbow trout for limited food and other resources which would explain the smaller than expected size for rainbow trout.

Approximately 285 rainbow trout fingerlings/ha are stocked into Craig Lake on even years. In rural or remote lakes, fingerling rainbow trout are typically stocked at densities up to 500 $fish \bullet ha^{-1}$ (Skaugstad *In prep*).

Recommendations

- □ Continue biennial stockings of 2,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- □ Evaluate the rainbow trout population in Craig Lake again in 10 years.

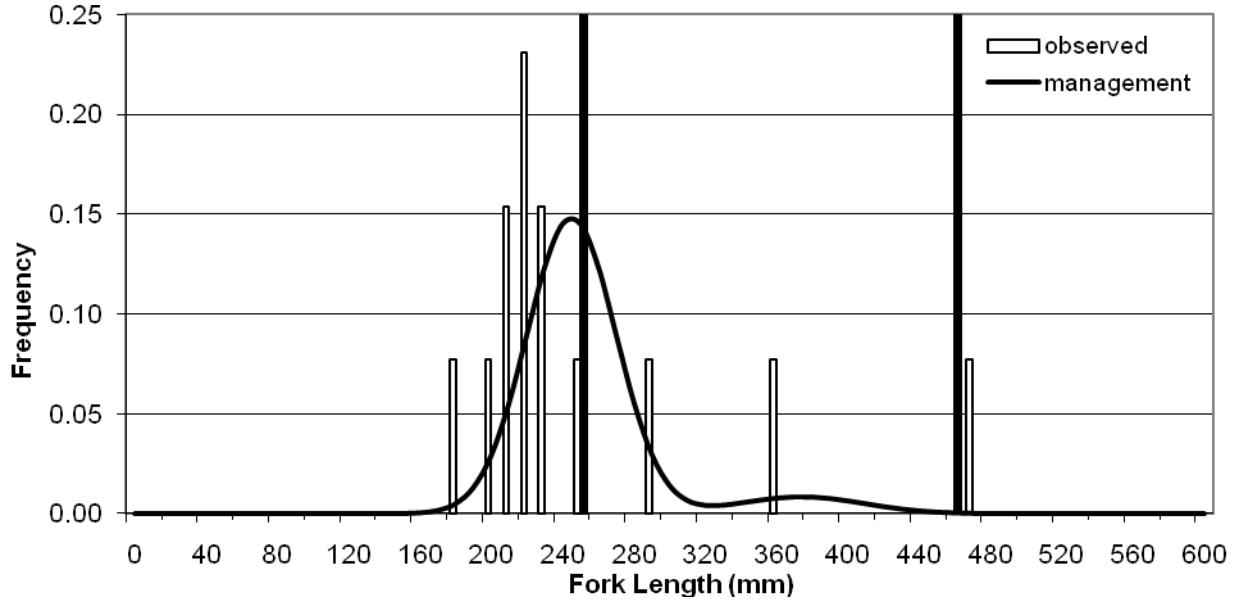

Figure 5.-Craig Lake: Length-frequency distribution for rainbow trout captured in spring 2008 (n=13) plotted with the management population structure.

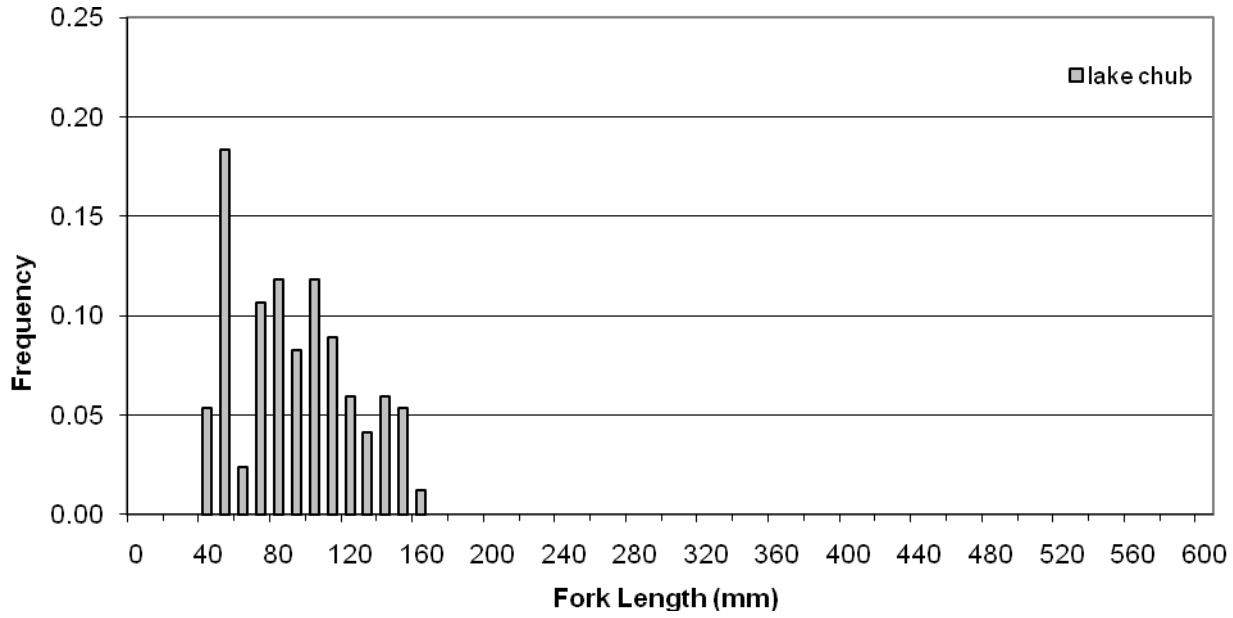

Figure 6.-Craig Lake: Length-frequency distribution for lake chub captured in spring 2008 (n=169).

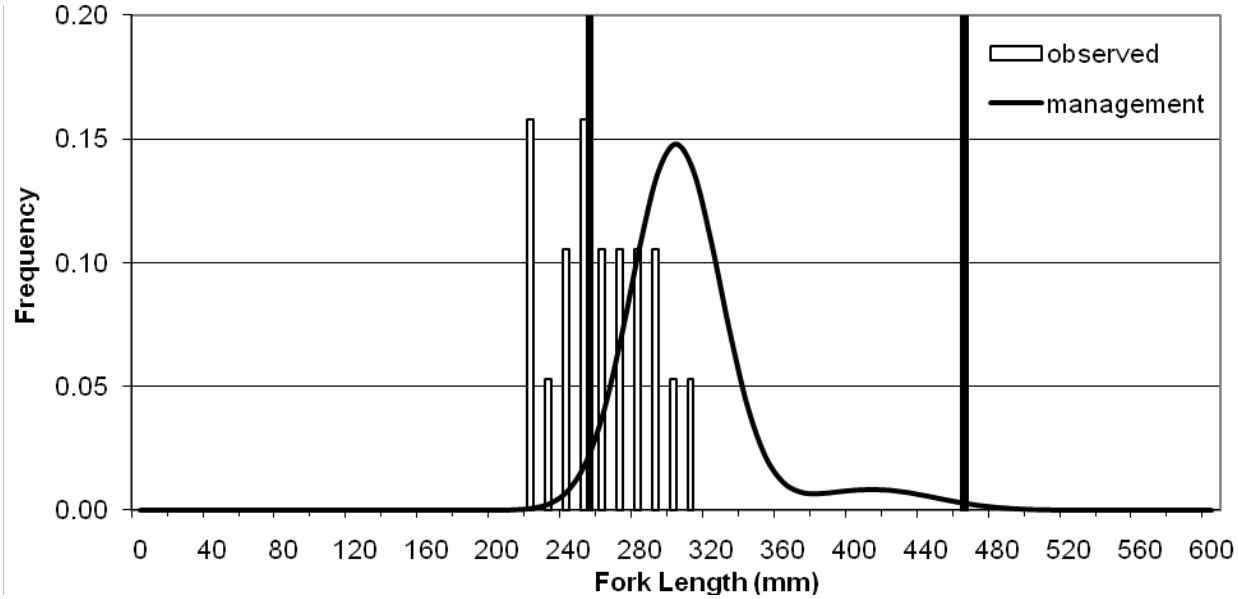

Figure 7.-Craig Lake: Length-frequency distribution for rainbow trout captured in fall 2010 (n=19) plotted with the management population structure.

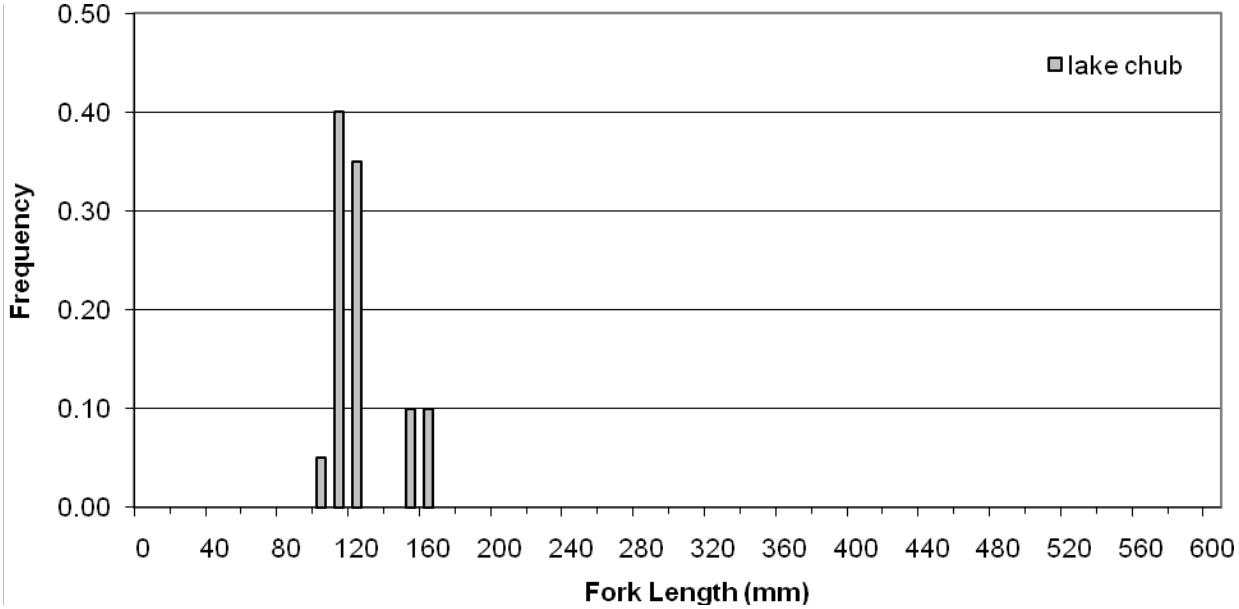

Figure 8.-Craig Lake: Length-frequency distribution for lake chub captured in fall 2010 (n=20).

Table 4.-Craig Lake: Test results by length category for rainbow trout captured in fall 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	8	11	230	275
	(0.42[a])	(0.58[a])	(3.77[b])	(5.32[b])
Management Criteria	0	19	235	309
	(0.01[a])	(0.99[a])		
Test Stat		324.3	-1.424	-6.458
DF		1	7	10
P Value		<0.0001	0.0987	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 5.-Craig Lake: Test results by age cohort for rainbow trout captured in fall 2010.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	0	19 (1.00[a])	0	0	0	-	256 mm (6.24[b])	-	-	-
Management Criteria	0	18 (0.93[a])	0	1 (0.07[a])	0	210 mm	300 mm	370 mm	410 mm	450 mm
Test Stat		-[c]				-	-7.107	-	-	-
DF		-[c]				-	18	-	-	-
P Value		-[c]				-	<0.0001	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort captured. Statistical analysis could not be performed.

Ken's Pond

Ken's Pond was sampled June 11–12, 2008. The maximum water temperature measured 1 m beneath the surface was 13.2°C. Forty seven rainbow trout (Figure 9) and six Arctic char (125-305 mm) were captured in fyke nets and appeared to be in good condition. The mean length for the fish in defined length categories was similar to management criteria, although the proportion of fish in each category did not resemble the management population structure (Table 6). Age cohorts could not be determined. Visual comparison of the observed rainbow trout LFD suggested that only one age cohort was present, but we could not determine whether these were large age-2 or small age-4 fish. Because the mean length for fish captured in defined length categories resembled expected values we considered management criteria achieved for rainbow trout in Ken's Pond.

Ken's Pond is high elevation (863 m), the substrate is sand and cobble up to 20 cm diameter with sparse aquatic vegetation around the perimeter. Previously recorded temperature and D.O. in Ken's Pond were adequate for rainbow trout. Limnology data collected in July 2008 indicated that D.O. was > 4 mg•L^{-1} throughout 77% of the water column and thermal refuge was present throughout the entire water column (≤ 13.2°C). Late winter limnology sampling has not been conducted at Ken's Pond but the presence of fish from previous stockings indicate that winter D.O. was adequate to support fish.

The stocking density of rainbow trout and Arctic char in Ken's Pond was 275 fish•ha^{-1}. Captured fish were robust and there was no indication that the fish population was exceeding food resources.

Ken's Pond is not specifically reported in the Statewide Harvest Survey, but fishing effort and harvest for all Coal Mine Road lakes as a group is sufficient to generate and report annual estimates of effort, catch, and harvest. This area is very popular for hiking, hunting, and fishing.

Recommendations

- Continue biennial stockings of 1,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- Continue biennial stockings of 375 Arctic char subcatchables (4 g or 70 mm), target release date mid-June. Arctic char are stocked in years that rainbow trout are not stocked.
- Evaluate the rainbow trout and Arctic char populations in Ken's Pond again in 10 years.
- Increase the use of tangle nets in deeper areas of the lake during future sampling projects to capture Arctic char that may avoid near shore areas.
- Record temperature and D.O. profiles during mid-March prior to evaluating the fishery again.

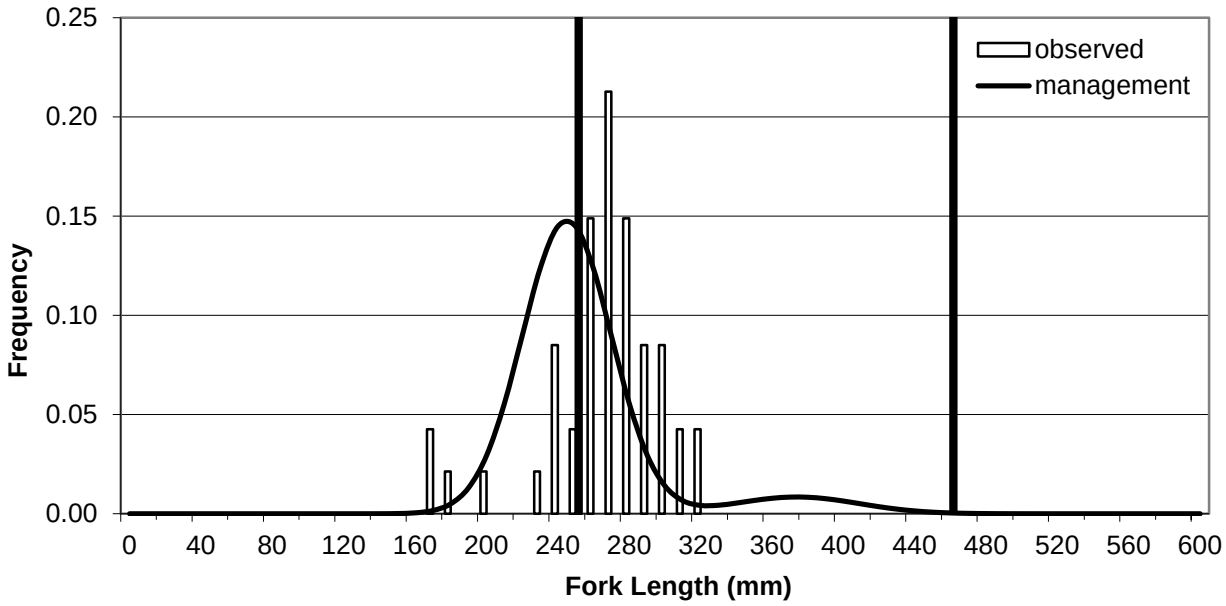

Figure 9.-Ken's Pond: Length-frequency distribution for rainbow trout captured in spring 2008 (n=47) plotted with the management population structures.

Table 6.-Ken's Pond: Test results by length category for rainbow trout captured in spring 2008.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	10	37	212 mm	275 mm
	(0.21[a])	(0.79[a])	(10.08[b])	(2.90[b])
Management Criteria	22	25	225 mm	279 mm
	(0.46[a])	(0.54[a])		
Test Stat		11.57	-1.25	-1.28
DF		1	9	36
P Value		0.0007	0.1214	0.1049

[a] Proportion of catch.

[b] Standard error.

Monte Lake

The rainbow trout population was sampled August 19–21, 2008. Water temperature 1 m beneath the surface ranged from 14.0 to 14.1°C. Twelve rainbow trout (Figure 10) and 24 slimy sculpin *Cottus cognatus* (Figure 11) were captured. One rainbow trout was captured in a tangle net and all other fish were captured in fyke nets. All fish were in good condition and had no external signs of parasite or disease. Too few rainbow trout were captured to perform statistical analysis; however, visual inspection of the observed LFD indicated that age-2 and age-4 fish were present in the lake. Age-2 fish (average FL 258 mm) appeared to be slightly smaller than expected (300 mm) and age-4 fish (average FL 444 mm) appeared to be slightly larger (410 mm). Although few fish were captured, we concluded that management criteria were achieved for rainbow trout in Monte Lake because of the presence and size of age-4 fish.

Limnology data collected in August 2008 indicated that both temperature and D.O. were more than adequate to support fish. D.O. was > 6 mg•L^{-1} throughout 83% of the water column and water temperature at the same location ranged from 13.3°C at the surface to 6.4°C at the bottom. Late winter limnology sampling has not been conducted at Monte Lake but the presence of fish from previous stockings indicates that winter water quality parameters were adequate to support fish.

The Monte Lake fishery falls under the Special Management approach. Fishing has been reported in the Statewide Harvest Survey in 1998, 1999, and 2000, but catch and harvest could not be evaluated due to too few respondents. The fishery is providing large fish but, based on the number of fish that we captured, the population abundance may not be sufficient to attract anglers to a location that is difficult to reach.

Low population abundance may be the result of lake habitat and predation rather than harvest. While sampling we noticed that most of the lake bottom was composed of cobble up to 30 cm diameter with sparse patches of aquatic vegetation. Fingerling rainbow trout prefer littoral areas with abundant vegetation providing refuge and forage (Tabor and Wurtsbaugh 1991). Without adequate refuge newly stocked rainbow trout are more susceptible to predation by older age cohorts and lake trout. Larger rainbow trout would be less susceptible to predation but are too costly to transport to a remote lake. Captured rainbow trout were robust, indicating the fish population was not exceeding food resources. The stocking density of rainbow trout in Monte Lake ranges between 275 fish•ha^{-1} and 412 fish•ha^{-1}.

Recommendations

- Continue biennial stockings of 15,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- Evaluate the rainbow trout population in Monte Lake again in 5 years.

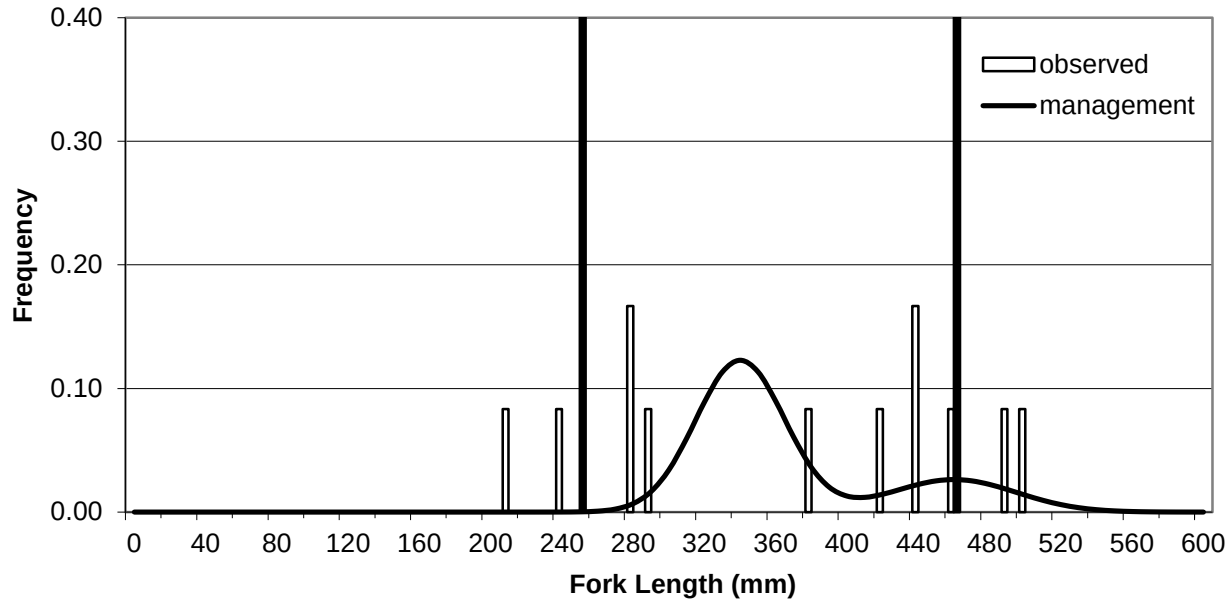

Figure 10.-Monte Lake: Length-frequency distribution for rainbow trout captured in fall 2008 (n=12) plotted with the management population structure.

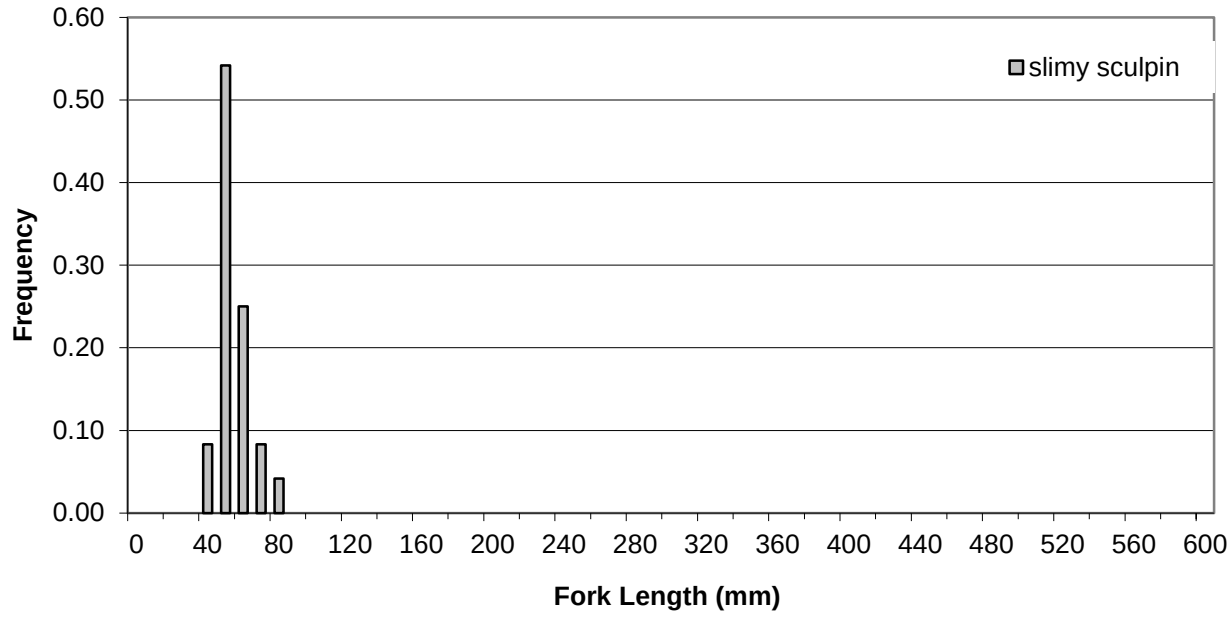

Figure 11.-Monte Lake: Length-frequency distribution for slimy sculpin captured in fall 2008 (n=24).

Coal Mine #5 Lake

Fish populations in Coal Mine #5 Lake were sampled June 11–12, 2009. Water temperature 1 m beneath the surface ranged from 15.5 to 16.2°C. Twenty eight rainbow trout (Figure 12) and two lake trout were captured. Lake trout measured 180 mm and 495 mm FL. All fish were captured in fyke nets except the largest lake trout was caught in a tangle net. Fish were in good condition and had no external signs of parasite or disease. Lake trout were last stocked into Coal Mine #5 Lake in 1991. The presence of a 180 mm lake trout indicated that natural reproduction likely occurred. Visual inspection of the observed LFD and a review of the stocking records (Appendix A) showed age-1 rainbow trout were missing from our catch. Most captured rainbow trout were probably age 3 but some larger fish may have been age 5. Because of this uncertainty we did not perform statistical analysis for age cohorts. The proportion of fish captured within specified length categories did not resemble management criteria. The observed mean length for fish ≥250 mm differed from management criteria (Table 7), but this difference was less than 25 mm and we did not consider it to be meaningful to anglers. Statistical analysis of fish <250 mm was not performed because only one fish was captured in this size category. Despite the absence of age-1 fish in our catch, we considered management criteria achieved for rainbow trout in Coal Mine #5 Lake.

Elevation of Coal Mine #5 Lake is (809 m) and aquatic vegetation is sparse. D.O. in March 2002 ranged from 9.1 mg•L^{-1} at 1 m to 4.1 mg•L^{-1} at 4.5 m.

Angler effort and harvest for Coal Mine #5 Lake is not estimated due to too few respondents in the Statewide Harvest Survey, but as stated earlier, all stocked lakes in the Coal Mine Road area are reported as a group annually.

Although rainbow trout abundance is influenced by habitat and harvest, we suspect that predation also has a significant effect in Coal Mine #5 Lake. Small, newly stocked rainbow trout were likely prey for larger rainbow trout and lake trout both in the lake and in our nets during sampling. Predation can be minimized by stocking larger fish. Survival rates of stocked rainbow trout in other Interior Alaska lakes improved when larger fingerling or subcatchable size fish were stocked (Behr and Skaugstad 2011). Stocking fingerlings in early June instead of August or September may also help increase the survival rate of rainbow trout because the fish have more time to grow larger before winter. However, lack of places for small fish to hide from predators may require stocking catchable size rainbow trout that are too large for predators.

Rainbow trout captured during spring 2009 were robust. The stocking density of rainbow trout in Coal Mine #5 Lake is 377 fish•ha^{-1} on alternate years.

Recommendations

- Continue biennial stockings of 2,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- Stock larger fingerlings, subcatchables, or catchables when larger size fish become available from the hatchery. To justify using larger fish, the benefit of an increase in survival rate to catchable size must outweigh the cost of the hatchery resources needed to produce them (Behr and Skaugstad 2011).
- Evaluate the rainbow trout population in Coal Mine #5 Lake again in 10 years.

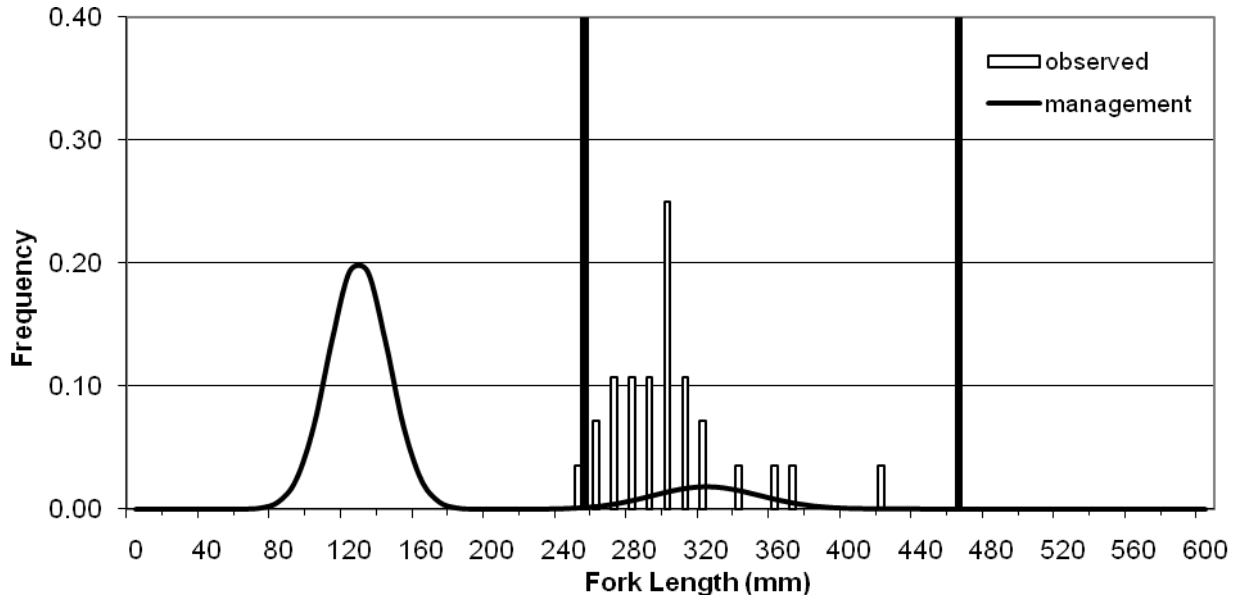

Figure 12.-Coal Mine #5 Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=28) plotted with the management population structure.

Table 7.-Coal Mine #5 Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	1	27	247 mm	299 mm
	(0.04[a])	(0.96[a])	(0.00[b])	(6.75[b])
Management Criteria	24	4	125 mm	321 mm
	(0.86[a])	(0.14[a])		
Test Stat		158.0	-[c]	-3.314
DF		1	-[c]	26
P Value		<0.0001	-[c]	0.0014

[a] Proportion of catch.

[b] Standard error.

[c] Only one fish was captured, data analysis could not be performed.

Doc Lake

We sampled the rainbow trout population at Doc Lake June 1–2, 2009. Water temperature 1 m beneath the surface ranged from 13.1 to 13.4°C. Two hundred thirty two rainbow trout were captured in fyke nets and appeared to be in good condition (Figure 13). Examination of the observed rainbow trout LFD and recent stocking records (Appendix A) indicated that most fish were age 3, four fish were age 1, and two fish were age 5. The observed mean length for fish <250 mm was greater than we expected (Table 8); however, this difference was the result of the age-3 cohort being smaller than expected and having its LFD divided nearly evenly at 250 mm (Table 9). We expected most of the age-3 cohort would be larger than 250 mm. Age-1 fish were 19 mm smaller than expected, but only four fish were captured. Age-3 and age-5 fish also were smaller than expected and the difference between expected and observed mean lengths was more than 25 mm. Management criteria for the rainbow trout in Doc Lake were not achieved.

Like many small, high alpine lakes, Doc Lake has a cobble bottom with very little aquatic vegetation. The lake has minimal shoreline development and sparse habitat for fingerling rainbow trout or forage.

Limnology data collected in June 2009 show D.O. > 5 mg•L^{-1} down to 3.5-4 m and then dropped to <1 mg•L^{-1} throughout the remainder of the water column. No data were available for late winter.

Angler effort at Doc Lake could not be directly evaluated due to too few respondents in the Statewide Harvest Survey, but all Meadows Road lakes as a group are reported annually. Meadows Road is within the U.S. Army Donnelly Training Area and a military permit is required for access. Before entering Meadows Road users must call in to an automated tracking system and report their permit number and intended activity. Data collected from this system indicated that user's declared fishing as their primary activity for 531 of the 2,889 user days reported in 2010 (John Haddix, Natural Resources Supervisor, U.S. Army Alaska, personal communication). Additionally, this estimate is low because not all users remember to call into the automated permit system prior to entering the area.

The stocking density of rainbow trout in Doc Lake is 416 fish•ha^{-1} on alternate years. This density is appropriate for most rural or remote lakes. If the number of harvested fish in Doc Lake is less than we anticipated then too many fish may be competing for sparse food resources. The captured fish were robust, which indicates the number of fish in the lake was not excessive. However, growth might be improved by stocking fewer fish.

Recommendations

- Reduce biennial stocking of rainbow trout fingerlings from 500 to 400 fish (2 g or 60 mm FL), target release date early June.
- Evaluate the rainbow trout population in Doc Lake again in 7 years.

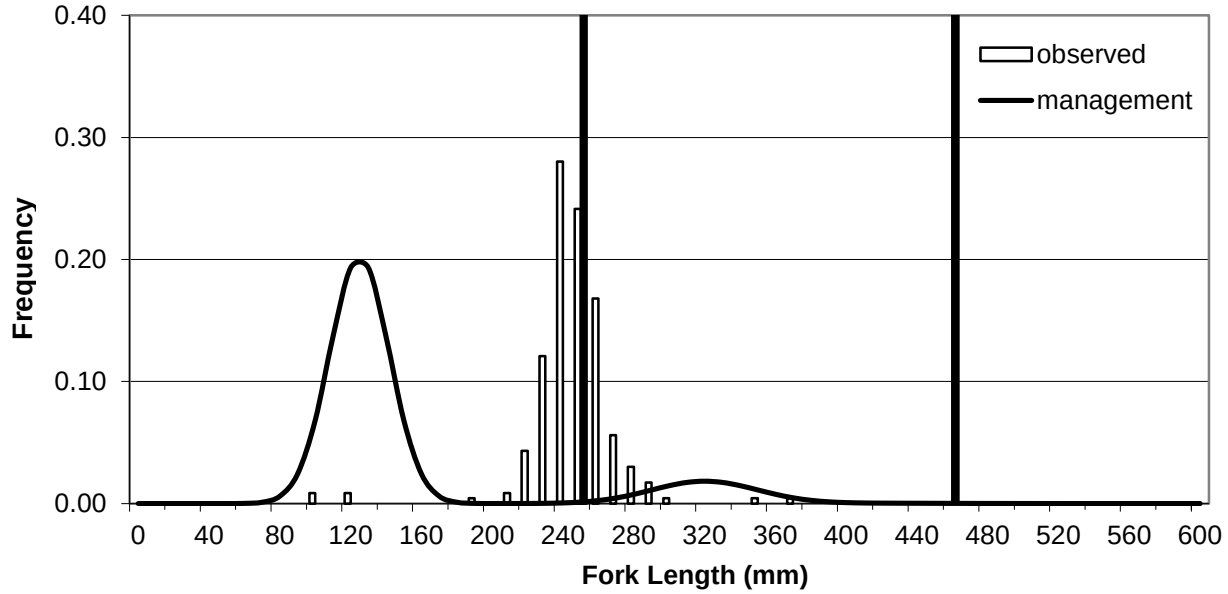

Figure 13.-Doc Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=232) plotted with the management population structure.

Table 8.-Doc Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	155	77	231 mm	263 mm
	(0.67[a])	(0.33[a])	(1.83[b])	(2.09[b])
Management Criteria	200	32	125 mm	320 mm
	(0.86[a])	(0.14[a])		
Test Stat		70.96	58.21	-27.48
DF		1	154	76
P Value		<0.0001	1.0000	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 9.-Doc Lake: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	4 (0.02[a])	0	226 (0.97[a])	0	2 (0.01[a])	106 mm (5.65[b])	-	243 mm (1.04[b])	-	355 mm (7.00[b])
Management Criteria	199 (0.86[a])	0	32 (0.14[a])	0	1 (0.00[a])	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		1,374				-3.320	-	-73.55	-	-8.714
DF		2				3	-	225	-	1
P Value		<0.0001				0.0225	-	<0.0001	-	0.0364

[a] Proportion of catch.

[b] Standard error.

Ghost Lake

Ghost Lake was sampled June 8–9, 2009. Maximum water temperature 1 m beneath the surface was 16.0°C. Arctic char were stocked in 2004, 2005, and 2006, but none were captured. Ninety four rainbow trout (Figure 14) and four slimy sculpin (62-82 mm) were captured in fyke nets and appeared to be in good condition. The observed LFD of rainbow trout indicated that fish were age 1 and age 3. Statistical analysis of fish captured within specified size categories and identified age cohorts indicated that the observed mean lengths for fish captured were slightly smaller than management criteria (Table 10 and 11); however, this difference was less than 25 mm in all categories and we did not consider it to be meaningful to anglers. The proportion of fish captured within specified size categories and identified age cohorts were not significantly different from management criteria (Table 10 and 11). Management criteria were achieved for rainbow trout in Ghost Lake.

Physical and chemical characteristics of Ghost Lake are adequate to support stocked rainbow trout and Arctic char. Ghost Lake has minimal shoreline development but unlike some high alpine lakes, it does have extensive aquatic vegetation in littoral areas. Limnology data collected in June 2009 showed D.O. > 5 mg•L^{-1} down to 5 m. No data were available for late winter, but the presence of age-3 fish indicated that winter conditions were suitable to support fish.

Water temperature at the time of sampling may explain why we didn't capture Arctic char. Water temperature was > 16°C 1.5 m beneath the surface during sampling and all fyke nets were set above this depth. A study on the thermal preference of Arctic char and brown trout in Sweden found that Arctic char preferred water temperature 10.8-11.8°C (Larsson 2005). Similarly, Mortensen et al. (2007) found that Arctic char in Norway preferred temperature 11.5-11.8°C during spring, summer, and fall. This research indicates that Arctic char may avoid warm littoral areas where fyke nets were set. Avoidance behavior by Arctic char to warm water may also explain why no Arctic char were captured in the tangle net. We suspect Arctic char are present in low numbers and our sampling effort was not sufficient to detect them. No rainbow trout were captured in the tangle net which suggests fish were able to avoid the net.

Angler effort in Ghost Lake could not be evaluated due to too few respondents in the Statewide Harvest Survey but fishing was reported in 2002 and 2005. Ghost Lake is located on Meadows Road and all lakes along Meadows Road are reported as a group annually.

Sample results indicate that current stocking numbers are sufficient to maintain a satisfactory fishery at Ghost Lake. The stocking density for Arctic char was 82 fish•ha^{-1} annually in 2004–2006, and the stocking density for rainbow trout was approximately 230 fish•ha^{-1} on even years. The total density of fish stocked into Ghost Lake does not exceed the density recommended for rural and remote lakes.

Recommendations

- □ Discontinue stocking Arctic char.
- □ Continue biennial stocking 500–1,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- □ Evaluate the rainbow trout population in Ghost Lake again in 7 years.

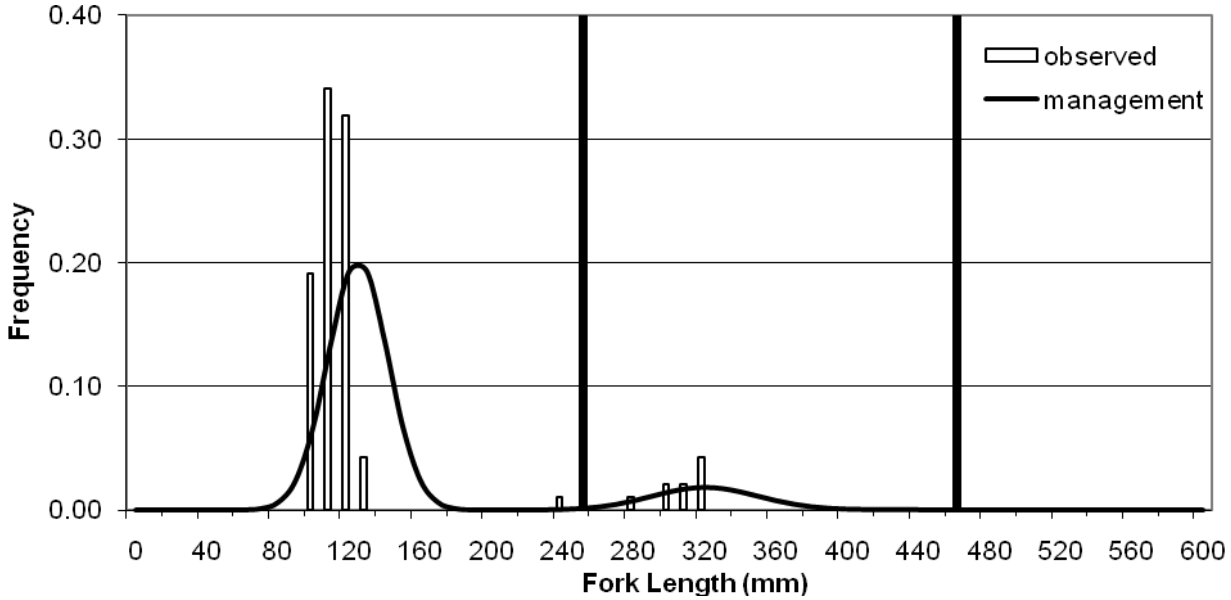

Figure 14.-Ghost Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=94) plotted with the management population structure.

Table 10.-Ghost Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	85	9	110 mm	305 mm
	(0.90[a])	(0.10[a])	(1.80[b])	(4.13[b])
Management Criteria	81	13	125 mm	320 mm
	(0.86[a])	(0.14[a])		
Test Stat		1.529	-8.628	-3.684
DF		1	84	8
P Value		0.2162	<0.0001	0.0031

[a] Proportion of catch.

[b] Standard error.

Table 11.-Ghost Lake: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	84 (0.89[a])	0	10 (0.11[a])	0	0	108 mm (0.93[b])	-	298 mm (7.55[b])	-	-
Management Criteria	81 (0.86[a])	0	13 (0.14[a])	0	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		0.882				-18.311	-	-2.889	-	-
DF		1				83	-	9	-	-
P Value		0.3476				<0.0001	-	0.0090	-	-

[a] Proportion of catch.

[b] Standard error.

Hidden Lake (Tok)

The rainbow trout population was sampled August 11–12, 2009. Water temperature was 13.8°C 1 m beneath the surface. Forty rainbow trout were captured (Figure 15). All but two fish were captured in fyke nets and all fish appeared to be in good condition. The observed LFD of rainbow trout indicated that captured fish were age 2. Statistical analysis of fish within specified size categories and identified age cohorts indicated the mean length of captured rainbow trout was similar to management criteria (Table 12 and 13). The proportion of fish captured also appeared to be similar to management criteria, but could not be statistically evaluated because only one age cohort and size category was present in the catch. Management criteria were achieved for Hidden Lake.

Hidden Lake has abundant aquatic vegetation. Limnology data collected in August 2009 indicated that D.O. was approximately 6 mg•L^{-1} down to 2-3 m and then abruptly declined to <1 mg•L^{-1} throughout the remainder of the water column. Temperature and D.O. profiles indicate that rainbow trout may become stressed during summer when the lake is thermally stratified. For rainbow trout, the epilimnion may reach temperatures that cause stress and D.O. in the cooler hypolimnion may approach the lower limits that the fish can endure. No data were available for late winter. The presence of age-2 fish indicates that rainbow trout are able to survive temporary harsh lake conditions.

Angler effort in Hidden Lake could not be evaluated due to too few respondents in the Statewide Harvest Survey; however, fishing is intermittently reported. Hidden Lake is located within the Tetlin National Wildlife Refuge and there is a voluntary log book located at the trail head. During May and June 2010 13% of users who signed the log book indicated that they had fished.[1]

Results indicate that current stocking numbers are sufficient to maintain a satisfactory fishery at Hidden Lake. The stocking density for rainbow trout is 380 fish•ha^{-1} on odd years. This does not exceed the density recommended for rural and remote lakes.

Recommendations

- □ Continue biennial stocking of 4,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- □ Evaluate the rainbow trout population in Hidden Lake again in 10 years.

[1] Tetlin National Wildlife Refuge, U.S. Fish and Wildlife Service, Hidden Lake Trail Register, unpublished data, 2010.

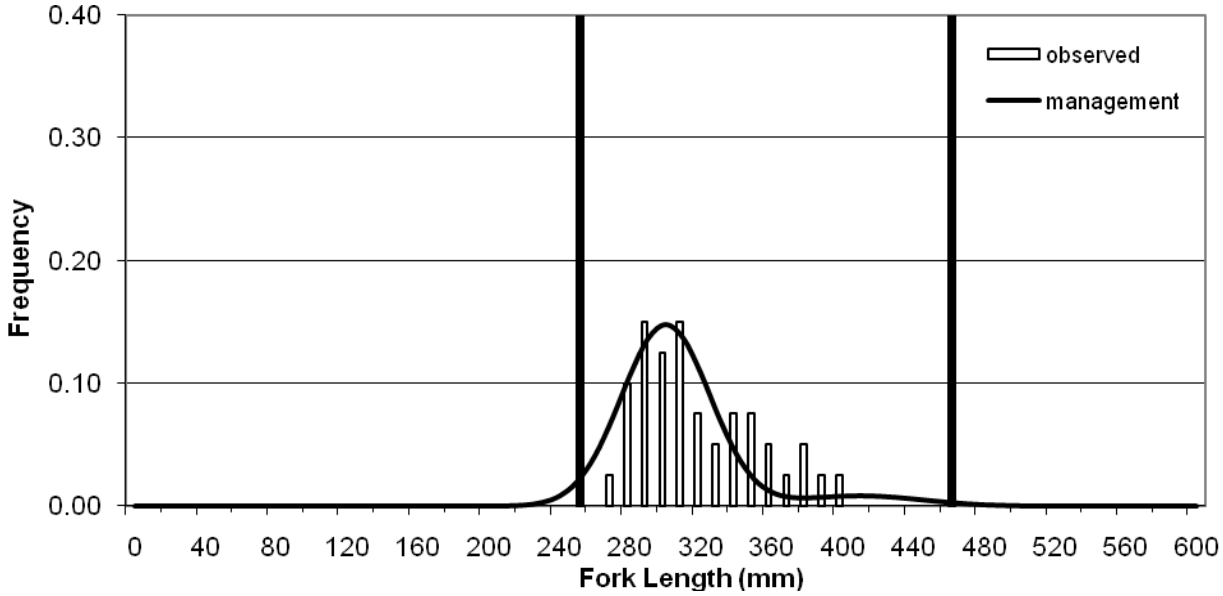

Figure 15.-Hidden Lake: Length-frequency distribution for rainbow trout captured in fall 2009 (n=40) plotted with the management population structure.

Table 12.-Hidden Lake: Test results by length category for rainbow trout captured in fall 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	0	40	-	316 mm
	(0.00[a])	(1.00[a])	-	(5.40[b])
Management Criteria	0	40	236 mm	309 mm
	(0.01[a])	(0.99[a])		
Test Stat		-[c]	-[c]	1.3341
DF		-[c]	-[c]	39
P Value		-[c]	-[c]	0.9051

[a] Proportion of catch.

[b] Standard error.

[c] Data analysis could not be performed because only fish ≥250 mm were captured.

Table 13.-Hidden Lake: Test results by age cohort for rainbow trout captured in fall 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	0	40 (0.89[a])	0	0	0	-	316 mm (5.40[b])	-	-	-
Management Criteria	0	37 (0.93[a])	0	3 (0.07[a])	0	210 mm	300 mm	370 mm	410 mm	450 mm
Test Stat		-[c]				-	3.0018	-	-	-
DF		-[c]				-	39	-	-	-
P Value		-[c]				-	0.9977	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort captured. Statistical analysis could not be performed.

Nickel Lake

Fish populations were sampled at Nickel Lake June 8–9, 2009. The water temperature during this time was 14.4°C 1 m beneath the surface. One hundred one rainbow trout (Figure 16), five Arctic char (128-136 mm FL), and 203 Arctic grayling (Figure 17) were captured in fyke nets and tangle nets and appeared to be in good condition. The observed LFD of rainbow trout indicated that captured fish were age 1 and age 3. Fish <250 mm were larger than management criteria (Table 14); however, further examination of the observed LFD suggests that this was due to age-3 rainbow trout being smaller than expected (Figure 16). Mean length of age-1 and age-3 rainbow trout captured in Nickel Lake was significantly less than management criteria (Table 15). Management criteria were not achieved for Nickel Lake.

Nickel Lake has moderate aquatic vegetation throughout the littoral area. Limnology data collected in June 2009 indicated that D.O. was > 5 $mg \bullet L^{-1}$ down to 7 m. No data were available for late winter, but the presence of multiple age cohorts of rainbow trout and Arctic grayling indicated that winter conditions were suitable to support fish.

Angler effort in Nickel Lake was reported in the Statewide Harvest Survey during 2000 and 2005, but could not be evaluated due to too few respondents.

Mean lengths for rainbow trout age cohorts were smaller than expected, which indicates that current stocking numbers for all species in Nickel Lake likely exceeds the lakes capacity to provide adequate food resources for fish to achieve expected sizes. The stocking density for rainbow trout is 415 $fish \bullet ha^{-1}$, Arctic grayling are stocked at 435 $fish \bullet ha^{-1}$, and Arctic char at 50 $fish \bullet ha^{-1}$. All stockings total approximately 900 $fish \bullet ha^{-1}$ released on even years. This is nearly double the stocking density typically used for rural or remote lakes. We expect that reducing the number of fish released into the lake will result in larger mean lengths for all age cohorts.

Recommendations

- Reduce rainbow trout stockings to 500 fish stocked biennially (2 g or 60 mm FL), target release date early June.
- Reduce Arctic grayling stockings to 500 fish stocked biennially (2 g or 60 mm FL), target release date of early August.
- Continue biennial stocking 100 Arctic char (4 g or 75 mm), target release date of early June.
- Evaluate the Nickel Lake fishery again in 7 years.

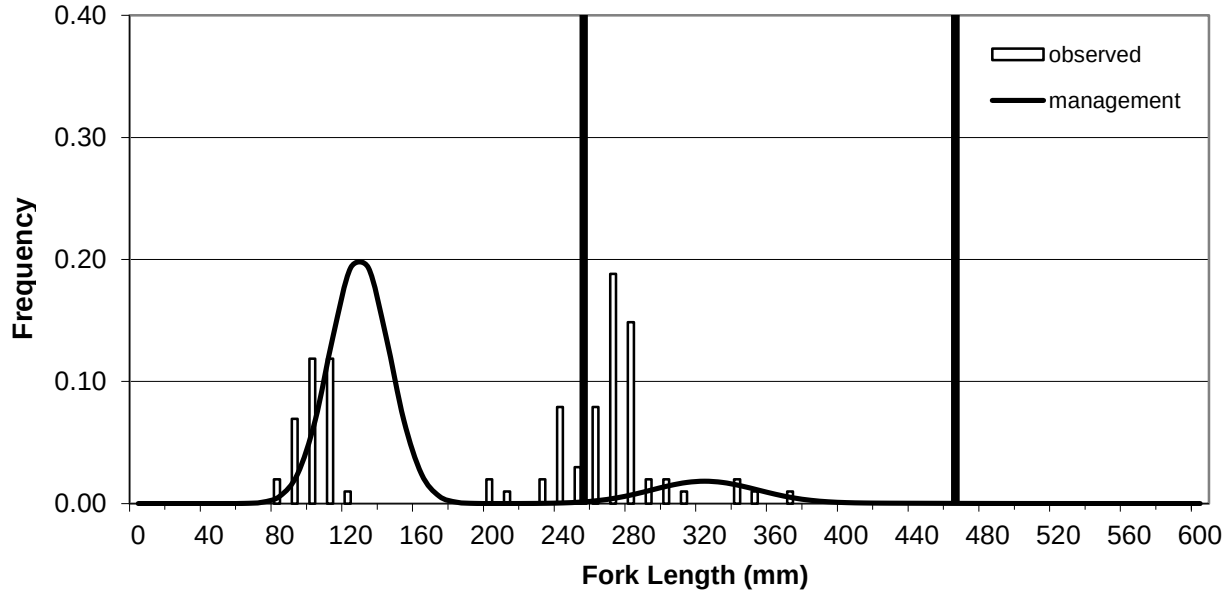

Figure 16.-Nickel Lake: Length-frequency distribution for rainbow trout captured during spring 2009 (n=101) plotted with the management population structure.

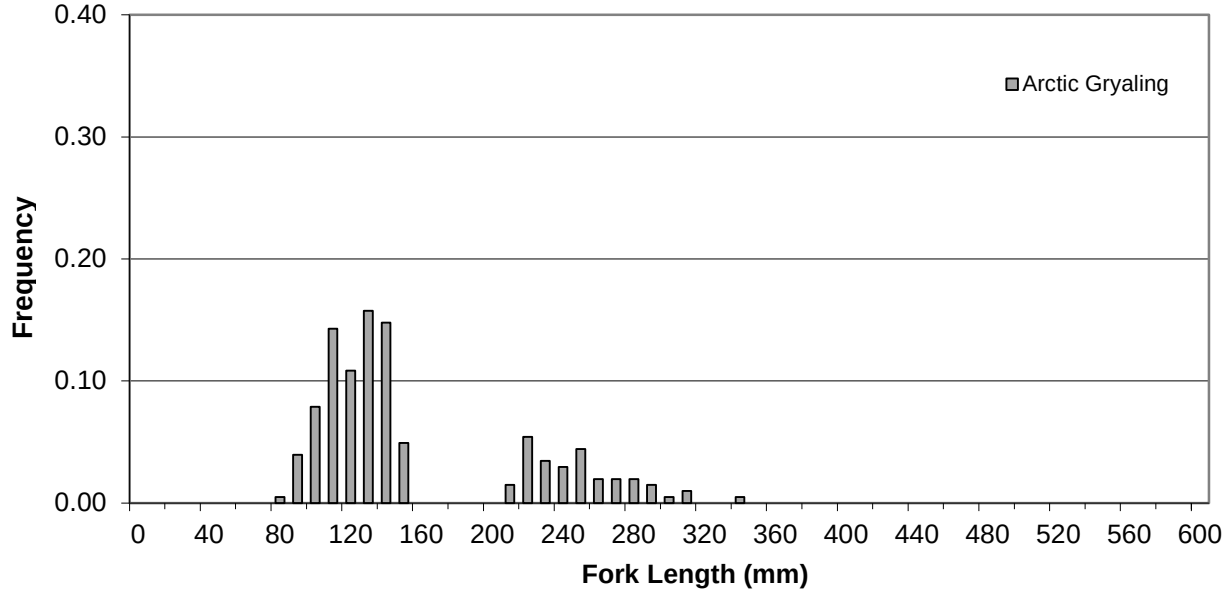

Figure 17.-Nickel Lake: Length-frequency distribution for Arctic grayling captured during spring 2009 (n=203).

Table 14.-Nickel Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	49	52	137 mm	275 mm
	(0.49[a])	(0.51[a])	(8.86[b])	(3.33[b])
Management Criteria	87	14	125 mm	320 mm
	(0.86[a])	(0.14[a])		
Test Stat		117.9	1.363	-13.47
DF		1	48	51
P Value		<0.0001	0.91045	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 15.-Nickel Lake: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	34 (0.34[a])	0	67 (0.66[a])	0	0	97 mm (1.67[b])	-	265 mm (3.66[b])	-	-
Management Criteria	87 (0.86[a])	0	14 (0.14[a])	0	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		229.8				-16.74	-	-15.15	-	-
DF		1				33	-	66	-	-
P Value		<0.0001				<0.0001	-	<0.0001	-	-

[a] Proportion of catch.

[b] Standard error.

Rockhound Lake

Fish populations were sampled at Rockhound Lake September 1–2, 2009. Water temperature was 11.9°C 1 m beneath the surface. Eighteen rainbow trout (Figure 18) and 33 lake trout (Figure 19) were captured in fyke nets except for one lake trout. Most captured fish were in good condition, with the exception of two lake trout which appeared to be skinny. The observed LFD of rainbow trout indicated that captured fish were age 1 and age 3. Fish <250 mm were not statistically different from management criteria (Table 16), but only three fish were captured in this size category. The observed mean length for fish ≥250 mm differed from management criteria (Table 16), but the difference was less than 25 mm and we did not consider it to be meaningful to anglers. The mean length of age-3 rainbow trout captured in Rockhound Lake was significantly less than management criteria and this difference was greater than 25 mm (Table 17). The proportion of fish captured within specified length categories and identified age cohorts did not resemble management criteria. Management criteria were achieved for rainbow trout in Rockhound Lake.

Rockhound Lake has moderate aquatic vegetation throughout the littoral area. Limnology data collected in September 2009 indicated that D.O. was > 6 mg•L^{-1} down to 3.5 m, and then dropped abruptly to <1 mg•L^{-1} throughout the remainder of the water column.

Lake trout were last stocked in Rockhound Lake in 1989. The small size and physical condition of the captured lake trout indicates that this species is not suited to the habitat in Rockhound Lake.

Angler effort in Rockhound Lake was reported in the Statewide Harvest Survey during 2005 but could not be evaluated due to too few respondents. Rockhound Lake is located behind North and South Twin Lake off Meadows Road and is a popular recreation destination that is relatively close to Delta Junction.

The stocking density for rainbow trout is 600 fish•ha^{-1} released on even years. This is high compared to other rural or remote lakes but our results indicate rainbow trout are meeting mean length criteria. However, because the lake is small it doesn't have the capability to produce the number of large fish that anglers desire to harvest. Stocking additional rainbow trout fingerlings will likely result in decreased length at age, reducing the attractiveness of the fishery. The affect that lake trout have on rainbow trout abundance by predation is difficult to determine based on the information at hand. However, if lake trout prey significantly on rainbow trout then the lake trout should have grown larger during the time they've been in the lake (at least 20 years).

Recommendations

- Continue biennial stocking of 600 rainbow trout (2 g or 60 mm FL), target release date early June.
- Evaluate the Rockhound Lake fishery again in 10 years.

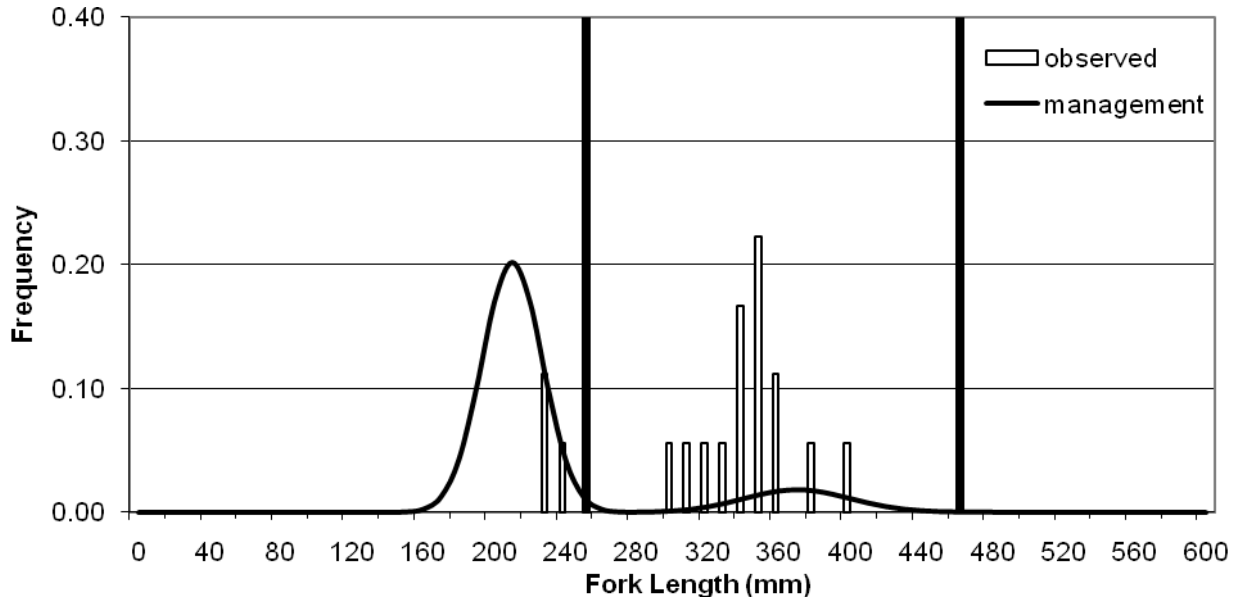

Figure 18.-Rockhound Lake: Length-frequency distribution for rainbow trout captured in fall 2009 (n=18) plotted with the management population structure.

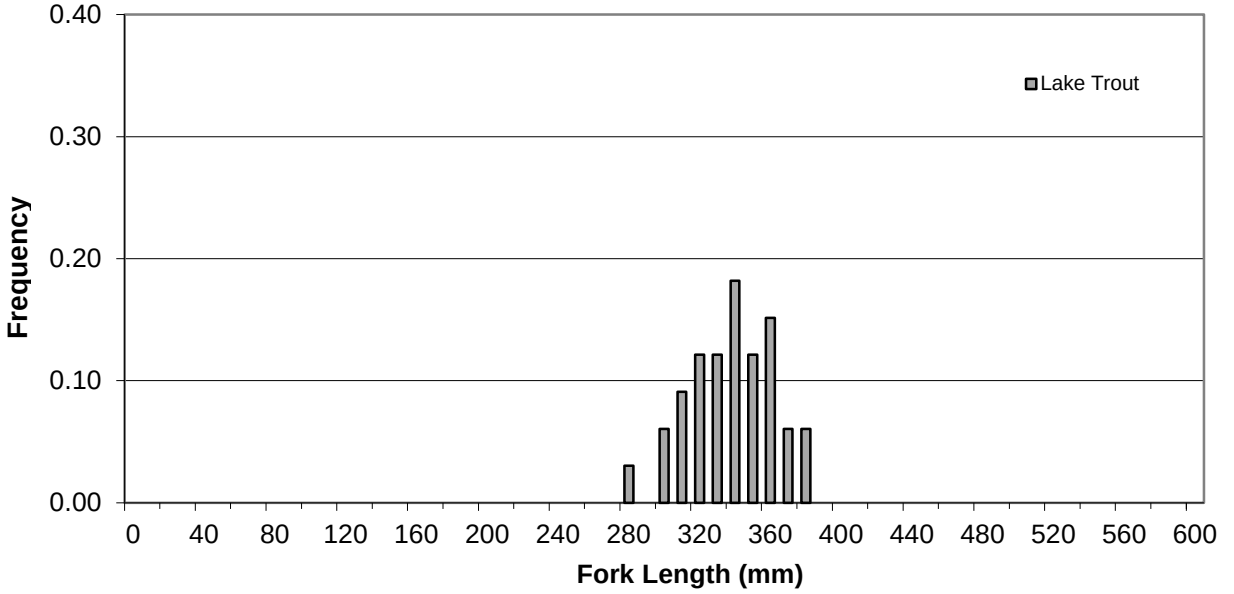

Figure 19.-Rockhound Lake: Length-frequency distribution for lake trout captured in fall 2009 (n=33).

Table 16.-Rockhound Lake: Test results by length category for rainbow trout captured in fall 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	3	15	227 mm	342 mm
	(0.17[a])	(0.83[a])	(2.19[b])	(6.54[b])
Management Criteria	15	3	209 mm	359 mm
	(0.84[a])	(0.16[a])		
Test Stat		60.72	8.082	-2.640
DF		1	2	14
P Value		<0.0001	0.9925	0.0097

[a] Proportion of catch.

[b] Standard error.

Table 17.-Rockhound Lake: Test results by age cohort for rainbow trout captured in fall 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	3 (0.17[a])	0	15 (0.83[a])	0	0	227 mm (2.19[b])	-	342 mm (6.54[b])	-	-
Management Criteria	15 (0.86[a])	0	3 (0.14[a])	0	0	210 mm	300 mm	370 mm	410 mm	450 mm
Test Stat		71.87				7.625	-	-4.322	-	-
DF		1				2	-	14	-	-
P Value		<0.0001				0.9916	-	0.0004	-	-

[a] Proportion of catch.

[b] Standard error.

Bluff Cabin Lake

The rainbow trout fish population was sampled August 11–12, 2010. Water temperature 1 m beneath the surface was 17.2°C. One hundred forty-four rainbow trout (Figure 20) were captured. Fifty seven fish were captured in tangle nets and 87 in fyke nets. All fish appeared to be in good condition and had no external signs of parasite or disease. Fish <250 mm were young of the year and were not used in data analysis. Visual inspection of the observed LFD indicated that age-2 and possibly age-4 fish were captured. The observed mean length of fish ≥250 mm was significantly different than management criteria (Table 18); however, this difference was less than 25 mm and we did not consider it to be meaningful to anglers. The mean length of age-2 fish was less than expected (Table 19), but this difference was also less than 25 mm. The mean length of age-4 fish was significantly different from management criteria. Despite slightly smaller than expected growth, management criteria were achieved for rainbow trout in Bluff Cabin Lake.

Bluff Cabin Lake has abundant aquatic vegetation in littoral areas and around the entire lake perimeter. D.O. was not measured during fall 2010 sampling, but was > 3 $mg \bullet L^{-1}$ from 0-3 m in March 2000 and > 7 $mg \bullet L^{-1}$ throughout the entire water column in June 2000. This, and the presence of multiple age cohorts, indicates that water quality parameters are sufficient to sustain fish.

Sport fishing in Bluff Cabin Lake was reported in the Statewide Harvest Survey for eight of the previous 10 years, but could not be evaluated due to too few respondents. Bluff Cabin Lake is accessible by a 5.6 km trail that can be very muddy during periods of high precipitation. Anecdotal evidence suggests access does not discourage anglers, the trail is well traveled and during stocking trips we often see people on the trail and at the lake fishing.

Although the mean length of fish captured in Bluff Cabin Lake was slightly less than management criteria, the current stocking scheme is maintaining a satisfactory fishery. Rainbow trout fingerling were stocked at approximately 240 $\bullet ha^{-1}$ on even years. This density is comparable to other lakes in rural or remote areas.

Recommendations

- Continue biennial stockings of 7,000 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- Evaluate the rainbow trout population in Bluff Cabin Lake again in 10 years.

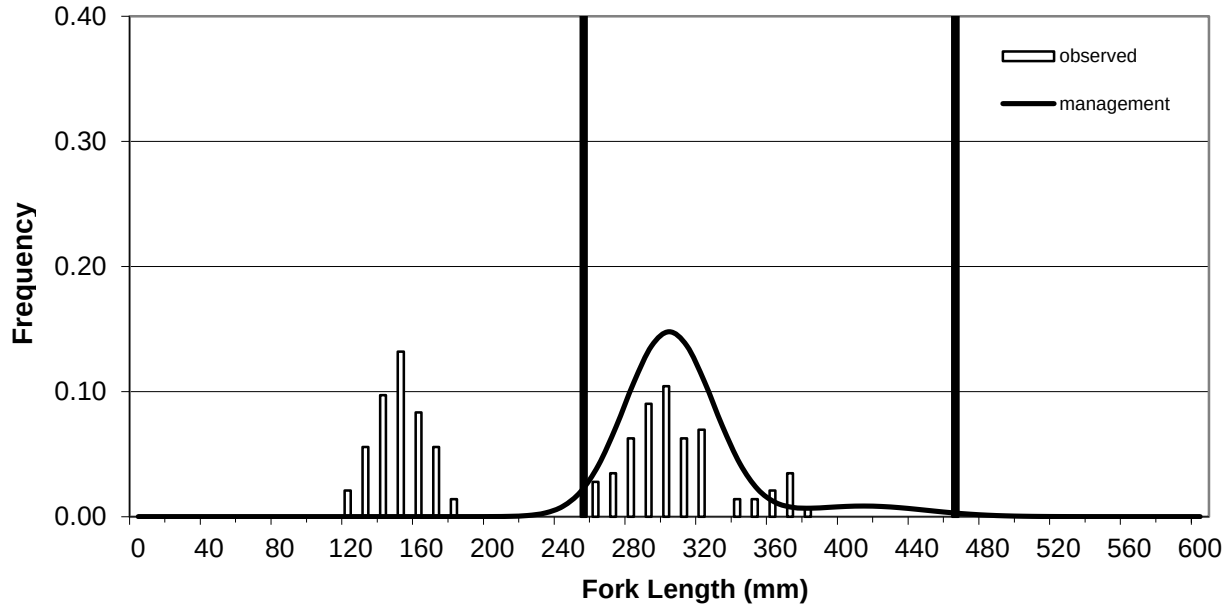

Figure 20.-Bluff Cabin Lake: Length-frequency distribution for rainbow trout captured in fall 2010 (n=144) plotted with the management population structure.

Table 18.-Bluff Cabin Lake: Test results by length category for rainbow trout captured in fall 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	-[c]	78	-[c]	301 mm
	-[c]	(1.00[a])	-[c]	(3.32[b])
Management Criteria	1	77	236 mm	309 mm
	(0.01[a])	(0.99[a])		
Test Stat		-[c]	-[c]	-2.354
DF		-[c]	-[c]	77
P Value		-[c]	-[c]	0.0106

[a] Proportion of catch.

[b] Standard error.

[c] Fish <250 mm were young of the year and not used in data analysis. Statistical analysis could not be performed.

Table 19.-Bluff Cabin Lake: Test results by age cohort for rainbow trout captured in fall 2010.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	0	65 (0.83[a])	0	13 (0.17[a])	0	-	290 mm (2.15[b])	-	355 mm (3.84[b])	-
Management Criteria	0	73 (0.93[a])	0	5 (0.07[a])	0	210 mm	300 mm	370 mm	410 mm	450 mm
Test Stat		11.20				-	-4.439	-	-14.352	-
DF		1				-	64	-	12	-
P Value		0.0008				-	<0.0001	-	<0.0001	-

[a] Proportion of catch.

[b] Standard error.

Rapids Lake

Rapids Lake was sampled June 15–16, 2010. Water temperature 1 m beneath the surface ranged from 9.4 to 10.8°C. Twenty-four rainbow trout (Figure 21) and six lake trout (175-350 mm FL) were captured in fyke nets and appeared to be in good condition, having no external signs of parasite or disease. Visual inspection of the observed rainbow trout LFD indicated that age-2 and age-4 fish were captured. Rainbow trout <250 mm were slightly smaller than anticipated, but this difference was less than 25 mm, and fish ≥250 mm were slightly larger (Table 20). Similarly, age-2 rainbow trout were smaller than management criteria and age-4 fish were larger than criteria (Table 21). Despite a small sample size and the age-2 cohort being smaller than expected we considered management criteria achieved for rainbow trout.

Rapids Lake is long (680 m) and narrow (65 m). The substrate is comprised of large boulders. We observed only a small amount of aquatic vegetation located at the south end of the lake. D.O. was not measured during spring 2010 sampling, but previous data indicated adequate D.O. during summer (> 9 $mg \bullet L^{-1}$ throughout the entire water column in August 2003), and the presence of multiple age cohorts indicates that water quality parameters are sufficient to sustain fish through winter.

Sport fishing in Rapids Lake is reported sporadically in the Statewide Harvest Survey but could not be evaluated due to too few respondents. The current stocking scheme for rainbow trout fingerlings (approximately 550 $fish \bullet ha^{-1}$ on alternate years) appears to be sufficient to maintain an adequate fishery. The stocking density is slightly higher than other rural or remote lakes, but harvest and likely predation by lake trout keep the rainbow trout population within limits that promote adequate growth.

Recommendations

- Continue biennial stockings of 1,500 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- Stock larger fingerlings, subcatchables, or catchables when fish become available from the hatchery. To justify using larger fish, the benefit of an increase in survival rate to catchable size must outweigh the cost of the hatchery resources needed to produce them (Behr and Skaugstad 2011).
- Evaluate the rainbow trout population in Rapids Lake again in 10 years.

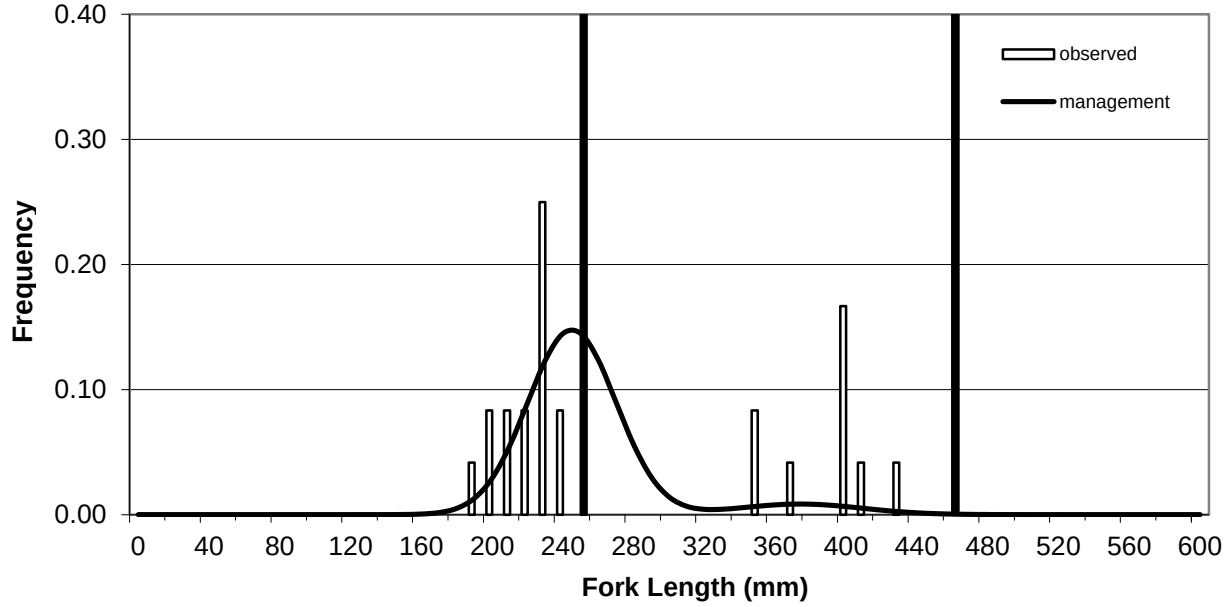

Figure 21.-Rapids Lake: Length-frequency distribution for rainbow trout captured in spring 2010 (n=24) plotted with the management population structure.

Table 20.-Rapids Lake: Test results by length category for rainbow trout captured in spring 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	15	9	217 mm	385 mm
	(0.62[a])	(0.38[a])	(3.68[b])	(8.85[b])
Management Criteria	11	13	225 mm	280 mm
	(0.46[a])	(0.54[a])		
Test Stat		2.5342	-2.2066	11.8717
DF		1	14	8
P Value		0.1114	0.0223	1.0000

[a] Proportion of catch.

[b] Standard error.

Table 21.-Rapids Lake: Test results by age cohort for rainbow trout captured in spring 2010.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	0	15 (0.62[a])	0	9 (0.38[a])	0	-	217 mm (3.68[b])	-	385 mm (8.85[b])	-
Management Criteria	0	22 (0.93[a])	0	2 (0.07[a])	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		34.2949				-	-7.6651	-	1.2562	-
DF		1				-	14	-	8	-
P Value		<0.0001				-	<0.0001	-	0.8778	-

[a] Proportion of catch.

[b] Standard error.

Robertson #2 Lake

Population sampling was conducted at Robertson #2 Lake August 24–25, 2010. Water temperature was 13.8°C 1 m beneath the surface. Twelve rainbow trout were captured but these fish where young of the year fingerlings stocked only two weeks prior to sampling. Age-2 and age-4 fish should have been present. Statistical analysis was not performed and management criteria were not achieved for Robertson #2 Lake.

Robertson #2 Lake is small and shallow with abundant aquatic vegetation throughout most of the lake. Limnology data collected during fish sampling found 0 mg•L^{-1} of D.O. from 2.5 m to 5.5 m. Decaying aquatic vegetation probably consumed D.O. and caused a winterkill of stocked rainbow trout.

Sport fishing in Robertson #2 Lake was reported in the Statewide Harvest Survey once in the last 10 years (in 2000), but could not be evaluated due to too few respondents.

We don't know how often winterkill events occur (every year or irregularly). Based on lake morphology and abundant aquatic vegetation we believe winterkill events are frequent. It is unlikely that an acceptable stocked fishery can be sustained using fingerling rainbow trout.

Recommendations

- □ Remove Robertson #2 from the Stocked Fisheries Program.

Lost Lake

Fish populations were sampled June 1–4, 2010. Water temperature ranged from 18.1 to 21.6°C 1 m beneath the surface. Three hundred eighty-two rainbow trout were captured, of which 169 were measured (Figure 22). Other species captured were the following: Sixty-five Arctic grayling (Figure 23), five Arctic char (111-536 mm), 21 longnose suckers *Catostomus catostomus* (Figure 24), 2,917 lake chub (of which 20 were measured, Figure 25), and one lake trout (490 mm). One longnose sucker, one lake trout, two Arctic char, and four rainbow trout were captured in tangle nets. All other fish were captured in fyke nets. Most fish appeared to be in good condition and had no external signs of parasite or disease; one Arctic char appeared skinny, and one rainbow trout had an unidentified parasite. Only age-1 fish could be identified from the observed LFD of measured rainbow trout (Figure 22). The mean length of measured rainbow trout ≥250 mm was larger than expected (Table 22); however, only 14 fish were measured in this length category. Age-1 fish appeared significantly smaller than management criteria (Table 23). Because very few large fish were present in the sample and because age-1 fish were significantly smaller than expected we concluded that management criteria for rainbow trout in Lost Lake were not achieved.

Lost Lake appears to have favorable characteristics for rainbow trout growth and survival. The lake has well established aquatic vegetation in the littoral area surrounding approximately half of the lake's perimeter. Data collected in July 2000 and June 2010 indicated that sufficient D.O. and thermal refuge was available during summer. In July 2000 and June 2010 D.O. was > 4 mg•L^{-1} down to 7 m. Water temperature was <10°C at depth > 4.5 m in July 2000 and at depth > 3 m in June 2010. Winter D.O. in Lost Lake appears to fluctuate and may occasionally reach sufficiently low concentrations that cause stress to rainbow trout. In December 1999, D.O. was <1 mg•L^{-1} at the surface and increased to 3.7 mg•L^{-1} at 11 m. Conversely, in January 2000 D.O. measured 8.8 mg•L^{-1} at 1 m and > 6 mg•L^{-1} down to 7 m, and in March 2000 D.O. measured 9.0

mg•L^{-1} at 1 m and > 6 mg•L^{-1} down to 7 m. We don't know why the winter D.O. profile was so different between years.

Older, larger rainbow trout in Lost Lake were most likely harvested. Lost Lake is across the Richardson Highway from Birch Lake, one of the largest sport fisheries in the Tanana River drainage. Sport fishing in Lost Lake is reported annually in the Statewide Harvest Survey; in 2003 anglers fished an estimated 661 days and caught 2,028 rainbow trout, 146 Arctic char, and 135 lake salmon (Chinook or coho) (Jennings et al. 2006). Angler effort could not be evaluated for all other years due to too few respondents, but we suspect it is high relative to lake size. There are more than a dozen homes and recreational cabins surrounding Lost Lake on the northeast shore, a boat ramp on the eastern end of the lake, and a Boy Scout recreational camp located on the southern shore.

The current stocking scheme for rainbow trout in Lost Lake is not sufficient to sustain this fishery. Rainbow trout fingerlings were stocked into Lost Lake beginning in 1952, in 1990 fingerling stockings were replaced with catchable size fish, and in 2007 fingerlings were again stocked due to restrictions on stocking catchable fish from Elmendorf Hatchery. Sampling results indicate that fingerling stockings are not maintaining this fishery. Very few fish ≥250 mm were captured and age-1 fish were significantly smaller than anticipated.

Recommendations

- □ Discontinue stocking fingerling rainbow trout.
- □ Stock 4,000 rainbow trout catchables (120 g or 213 mm FL), target release date early June.
- □ Evaluate the rainbow trout population in Lost Lake again in 7 years.

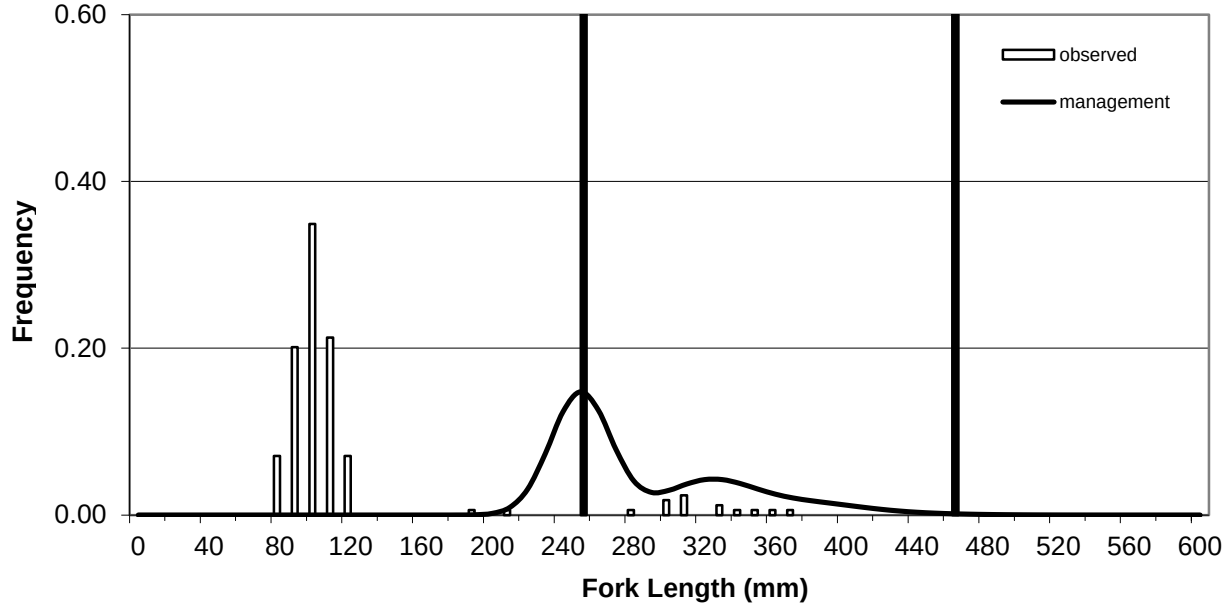

Figure 22.-Lost Lake: Length-frequency distribution for rainbow trout captured in spring 2010 (n=169) plotted with the management population structure.

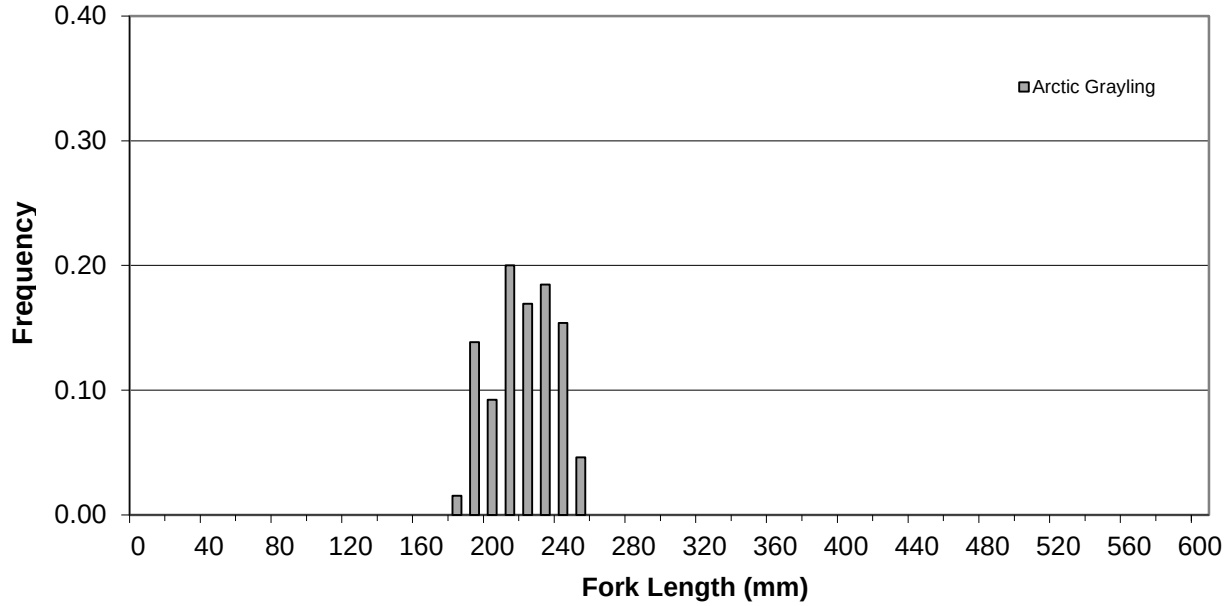

Figure 23.-Lost Lake: Length-frequency distribution for Arctic grayling captured in spring 2010 (n=65).

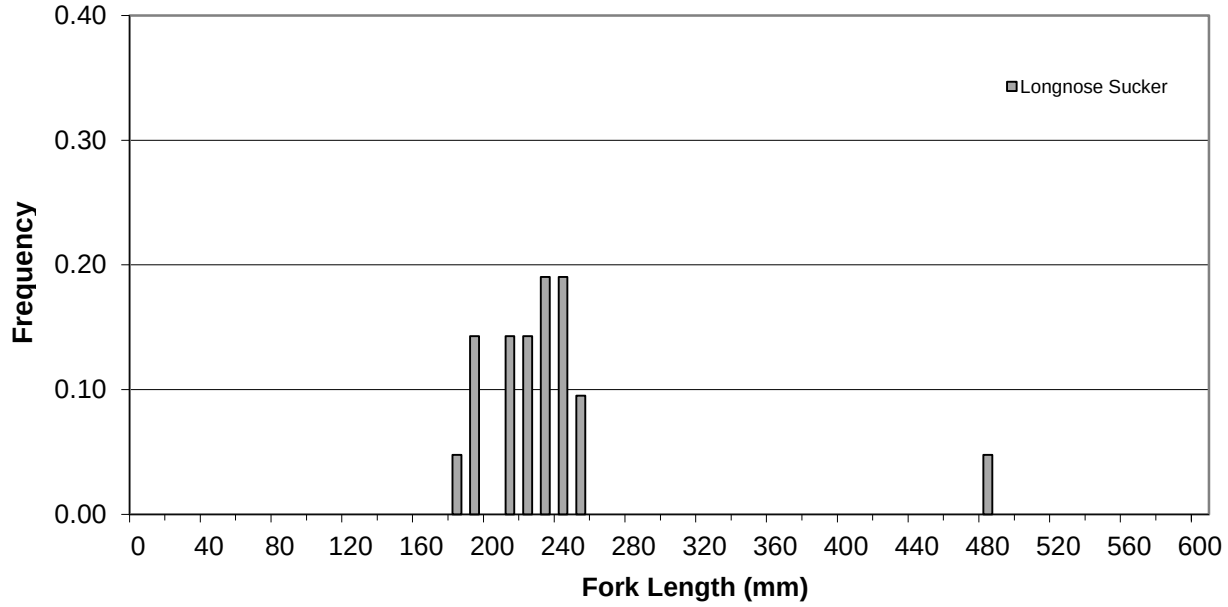

Figure 24.-Lost Lake: Length-frequency distribution for longnose sucker captured in spring 2010 (n=21).

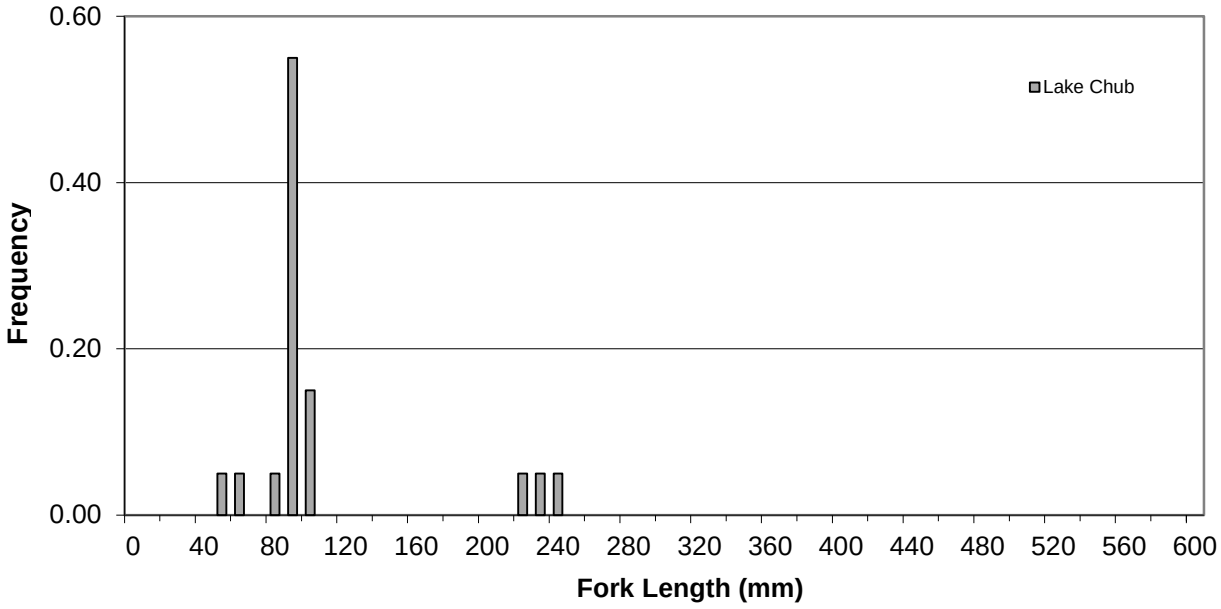

Figure 25.-Lost Lake: Length-frequency distribution for lake chub captured in spring 2010 (n=20).

Table 22.-Lost Lake: Test results by length category for rainbow trout captured in spring 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	155	14	97 mm	318 mm
	(0.92[a])	(0.08[a])	(1.22[b])	(7.30[b])
Management Criteria	78	91	225 mm	280 mm
	(0.46[a])	(0.54[a])		
Test Stat		140.2	-104.1	5.231
DF		1	154	13
P Value		<0.0001	<0.0001	0.9999

[a] Proportion of catch.

[b] Standard error.

Table 23.-Lost Lake: Test results by age cohort for rainbow trout captured in spring 2010.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	153 (0.91[a])	0	0	0	0	96 mm (0.80[b])	-	-	-	-
Management Criteria	0	157 (0.93[a])	0	12 (0.07[a])	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		-[c]				-36.018	-	-	-	-
DF		-[c]				152	-	-	-	-
P Value		-[c]				<0.0001	-	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort identified. Statistical analysis could not be performed.

Upper Copper / Upper Susitna River Management Area

Kathleen Lake

The rainbow trout population at Kathleen Lake was sampled June 16–17, 2009. Water temperature was 13.6°C 1 m beneath the surface. One hundred twenty-nine rainbow trout were captured (Figure 26) in fyke nets and appeared to be in good condition, having no external signs of parasite or disease. Visual inspection of the observed LFD and observations of body morphology by the field crew suggest a bimodal distribution of captured fish. Kathleen Lake was stocked only once prior to sampling with triploid rainbow trout fingerlings (Appendix A). A bimodal length distribution of triploid rainbow trout of the same age cohort has not been documented in the literature; however, hatchery personnel have observed more variability in the size of triploid rainbow trout during rearing than is typically observed within a single age cohort of diploid rainbow trout (Travis Hyer, Fish Culturist, Ruth Burnett Sport Fish Hatchery Fairbanks Alaska, personal communication). All fish captured were age 2 and significantly smaller than management criteria (Table 24 and 25). Management criteria were not achieved for Kathleen Lake.

Kathleen Lake has a small amount of aquatic vegetation along the shoreline. Limnology data collected in June 2009 indicated that D.O. was > 9 $mg \bullet L^{-1}$ throughout the entire water column. Field personnel also noted that D.O. concentration increased with lake depth. This trend is unusual and was observed in all three locations where physical and chemical data were collected. Limnology data were also collected during August 2005 and at this time D.O. and temperature values decreased with depth. D.O. in lake systems can be influenced by many things, including temperature, primary production, wind, weather, inlets, outlets, and groundwater. Some combination of these conditions may have caused the unusual trend in D.O. profiles observed during 2009 sampling. Similar trends have been documented in other Interior Alaska lakes, although we don't always know why this occurs. Monitoring temperature and D.O. for extended periods may help us understand these observations. No data were available for late winter but the presence of age-2 rainbow trout indicated that winter conditions were suitable to support fish.

Kathleen Lake is new to the Stocked Fisheries Program (initially stocked in 2007) and angler effort has not been reported in the Statewide Harvest Survey. Kathleen Lake is also remote, located northeast of Mankomen Lake and accessible only by trail. We suspect harvest has been minimal.

The LFD suggests poor growth. This is likely the result of too many rainbow trout in the lake due to higher survival rates than expected from the stocking in 2007. The stocking density was about 625 $fish \bullet ha^{-1}$ which is high compared to other rural or remote fingerling stockings. A higher stocking rate was used because the survival rate for triploid rainbow trout was expected to be less than that for diploid rainbow trout (Simon et al. 1993 and Kozfkay et al. 2006). Kathleen Lake was again stocked in 2010, but at a reduced rate of 350 $fish \bullet ha^{-1}$. This reduced stocking rate should be maintained until the next population evaluation.

Recommendations

- Continue biennial stocking 2,800 triploid rainbow trout (2 g or 60 mm FL), target release date early June.
- Evaluate the Kathleen Lake fishery again in 7 years and further document the bimodal distribution of triploid rainbow trout.

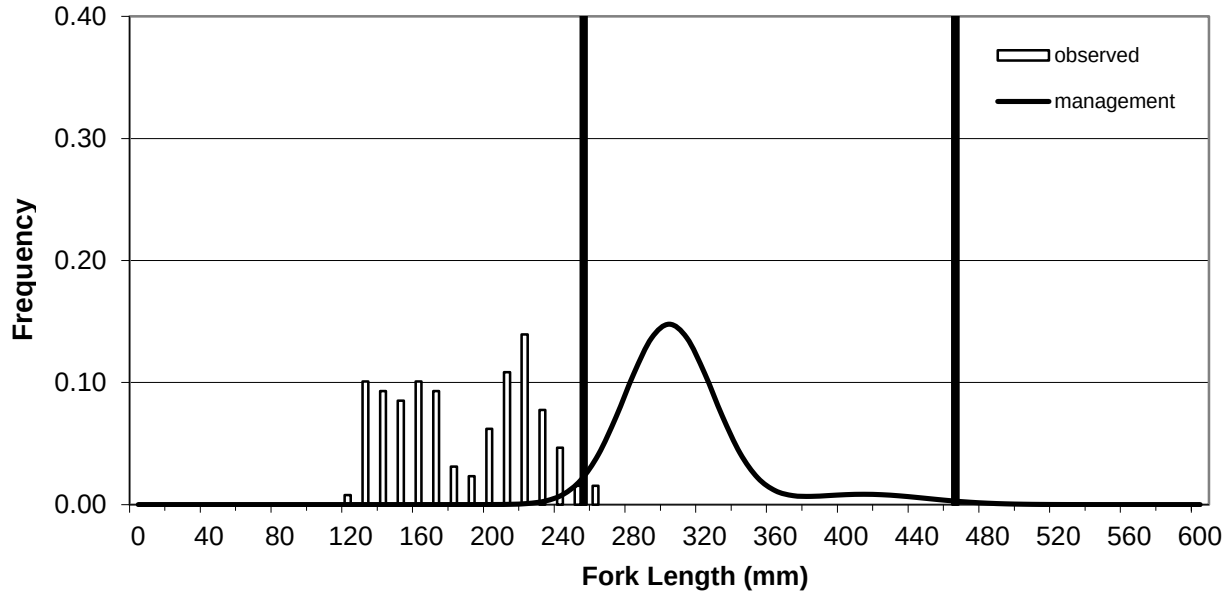

Figure 26.-Kathleen Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=129) plotted with the management population structure.

Table 24.-Kathleen Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	127	2	179 mm	253 mm
	(0.98[a])	(0.02[a])	(3.29[b])	(0.50[b])
Management Criteria	59	70	225 mm	280 mm
	(0.46[a])	(0.54[a])		
Test Stat		142.9	-14.07	-55.00
DF		1	126	14
P Value		<0.0001	<0.0001	0.0058

[a] Proportion of catch.

[b] Standard error.

Table 25.-Kathleen Lake: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	0	129 (1.00[a])	0	0	0	-	180 mm (3.34[b])	-	-	-
Management Criteria	0	120 (0.93[a])	0	9 (0.07[a])	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		-[c]				-	-19.52	-	-	-
DF		-[c]				-	128	-	-	-
P Value		-[c]				-	<0.0001	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort captured. Statistical analysis could not be performed.

Strelna Lake

Fish populations in Strelna Lake were sampled August 24–27, 2009. Water temperature was 15.5°C 1 m beneath the surface. Sixty-three rainbow trout (Figure 27) and 33 coho salmon (Figure 28) were captured in fyke nets and appeared to be in good condition. Age cohorts could not be determined because different groups of fish stocked in 2007 and 2008 were about the same size in 2009. In 2008, rainbow trout from Summit Lake in the Wrangell-St. Elias National Park were transferred to Strelna Lake as part of another project (Appendix A). These fish were from multiple age cohorts and had an average length of approximately 223 mm at time of release. Rainbow trout fingerlings from the hatchery were stocked in 2007. Fish captured within specified length categories were slightly smaller than management criteria and the proportion of fish captured within length categories were significantly different than expected (Table 26). We considered management criteria for rainbow trout in Strelna Lake achieved because the average lengths of fish captured within specified categories did not differ from expected values by more than 25 mm.

Strelna Lake has a narrow band of aquatic vegetation near shore. From shore there is a steep drop off along roughly two thirds of the perimeter. A relative small littoral area compared to surface area may not provide sufficient suitable habitat for the number of rainbow trout in the population. Such conditions may result in slower growth rates than expected. Limnology data collected in August 2009 indicated that D.O. was > 5 $mg \bullet L^{-1}$ throughout the entire water column.

Angler effort has been reported in the Statewide Harvest Survey annually over the last 10 years but could not be evaluated due to too few respondents. Strelna Lake is one of only three stocked lakes located along the McCarthy Road outside the community of Chitina. Alaska residents frequent this area to participate in the Copper River salmon fishery and residents and tourists visit the Kennecott Mine and Kennicott Glacier located at the end of the McCarthy Road.

Sample results indicate the current stocking scheme for Strelna Lake has maintained an acceptable fishery and stocking 1,000 catchable size rainbow trout from Summit Lake in 2008 most likely contributed to the success. Strelna Lake is usually stocked with fingerling rainbow trout and coho salmon on alternate years. Stocking was suspended in 2004 due to concerns of overstocking coho salmon. Coho salmon were stocked at approximately 290 $fish \bullet ha^{-1}$, but limited vegetation and littoral habitat may require stocking at a lower density. We began stocking fewer fish in 2007. Fingerling stockings of rainbow trout and coho salmon will likely support acceptable population structures but at low population abundances. Acceptable population structures can be maintained for both species as long as low numbers of fish are harvested. If harvest increases beyond what the fish populations can naturally sustain with fingerling stockings, we will need to consider stocking catchable fish or decide that the fishery will need to suffice on fingerling stockings.

Recommendations

- Continue biennial stocking 5,000 rainbow trout (2 g or 60 mm FL), target release date early June.
- Continue to stock rainbow trout from Summit Lake when available. Don't stock fingerling rainbow trout one year before or the same year that rainbow trout are transferred from Summit Lake.
- Reduce biennial stocking of coho salmon from 10,000 to 5,000 (2 g or 60 mm FL), target release date of early June.
- Evaluate the Strelna Lake fishery again in 7 years.

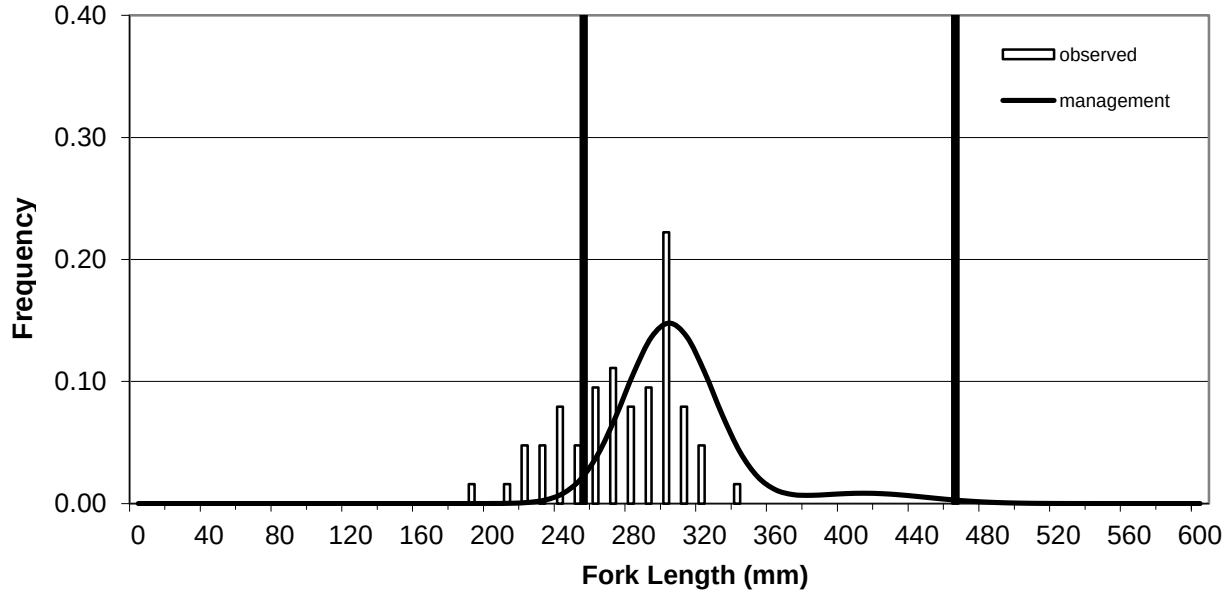

Figure 27.-Strelna Lake: Length-frequency distribution for rainbow trout captured in fall 2009 (n=63) plotted with the management population structure.

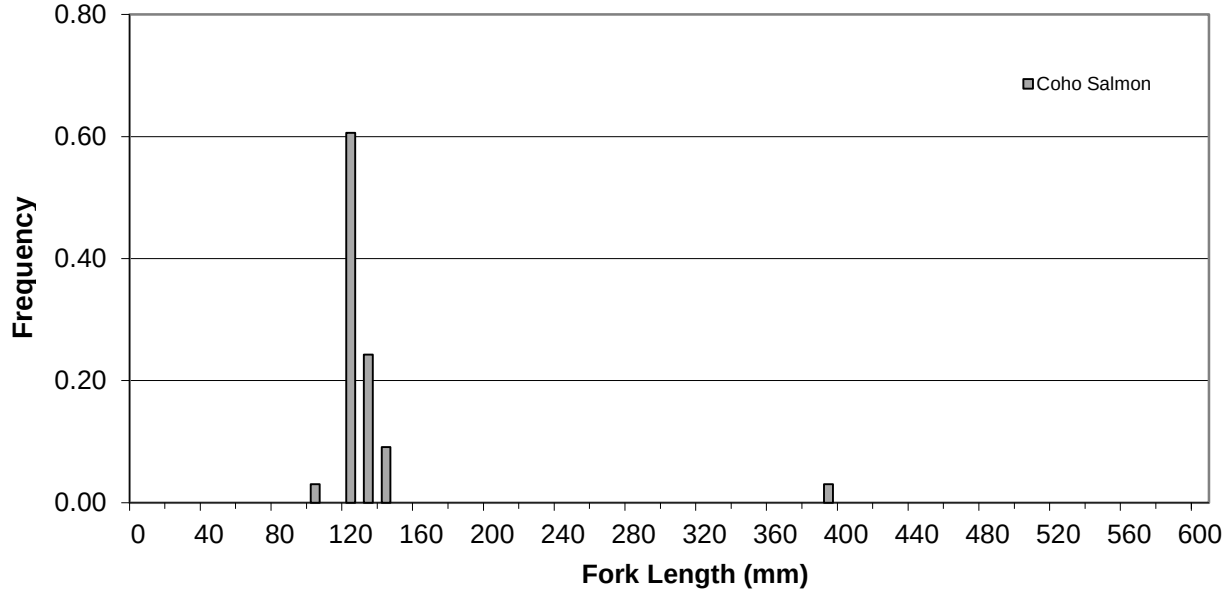

Figure 28.-Strelna Lake: Length-frequency distribution for coho salmon captured during fall 2009 (n=33).

Table 26.-Strelna Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	15	48	226 mm	285 mm
	(0.24[a])	(0.76[a])	(3.85[b])	(2.87[b])
Management Criteria	1	62	236 mm	309 mm
	(0.01[a])	(0.99[a])		
Test Stat		331.1	-2.582	-8.428
DF		1	14	47
P Value		<0.0001	0.0109	<0.0001

[a] Proportion of catch.

[b] Standard error.

Tolsona Lake

Fish populations were sampled at Tolsona Lake September 25–28, 2009. Water temperature was 13.2°C 1 m beneath the surface. Wild fish captured included 17 burbot *Lota lota* (Figure 29), two adult Arctic grayling (215 mm and 336 mm), eight Arctic grayling young of the year (not measured), >78 longnose suckers (not measured), and two slimy sculpin (not measured). Rainbow trout fingerlings were stocked in 2008, but none were captured. All fish were captured in fyke nets and appeared to be in good condition. Management criteria were not achieved for rainbow trout in Tolsona Lake.

Tolsona Lake is smaller and shallower than other lakes with burbot populations in this area (Schwanke 2009). Field crew observed abundant aquatic vegetation covering most of the lake at the time of sampling. Limnology data collected in August 2009 indicated that D.O. was > 10 mg•L^{-1} throughout most of the water column. Data collected during April 2010 indicated that D.O. dropped to <1 mg•L^{-1} below 1.5 m. Such low D.O. has been shown to result in multiple negative responses in rainbow trout. Davis (1975) reviewed the effects of low D.O. concentrations on Canadian species and lists decreased oxygen in the blood, reduced maximum swimming speed, increased toxicity of metals, decreased metabolic rate, and increased death as previously documented responses of rainbow trout.

Angler effort at Tolsona Lake has been reported in the Statewide Harvest Survey annually over the last 10 years but could not be evaluated due to too few respondents. Tolsona Lake is approximately 26 km from the community of Glennallen. There are numerous homes and recreational cabins around the lake, a lodge and restaurant, and an air taxi service. Although no

rainbow trout were captured during sampling, anglers did report catching rainbow trout in the 2009 Statewide Harvest Survey.

Tolsona Lake was stocked from 1966 to 1999. Stocking was discontinued in 1999 due to outlet and access issues, and resumed in 2008 after a public easement was secured and a new culvert was installed. The burbot fishery in Tolsona Lake has been closed since 1998 and local business owners and residents have requested that ADF&G continue to stock the lake with rainbow trout. In 2008, approximately 30,000 fingerling rainbow trout were stocked into Tolsona Lake. Sample results from 2009 indicate that stocking fingerling rainbow trout in Tolsona Lake did not result in a desirable fishery. However, it is likely that any rainbow trout fingerling captured in fyke nets was prey for burbot. Because burbot are present, we recommend stocking catchable rainbow trout. In 2008, catchable rainbow trout were not available due to restrictions on stocking catchable fish from Elmendorf Hatchery.

Recommendations

- □ Discontinue stocking rainbow trout fingerling.
- □ Stock 2,000 triploid catchable rainbow trout (120 g or 213 mm) when fish become available from the new Ruth Burnett Sport Fish Hatchery, target release date of late May or early June.
- □ Evaluate the Tolsona Lake fishery again in 7 years.

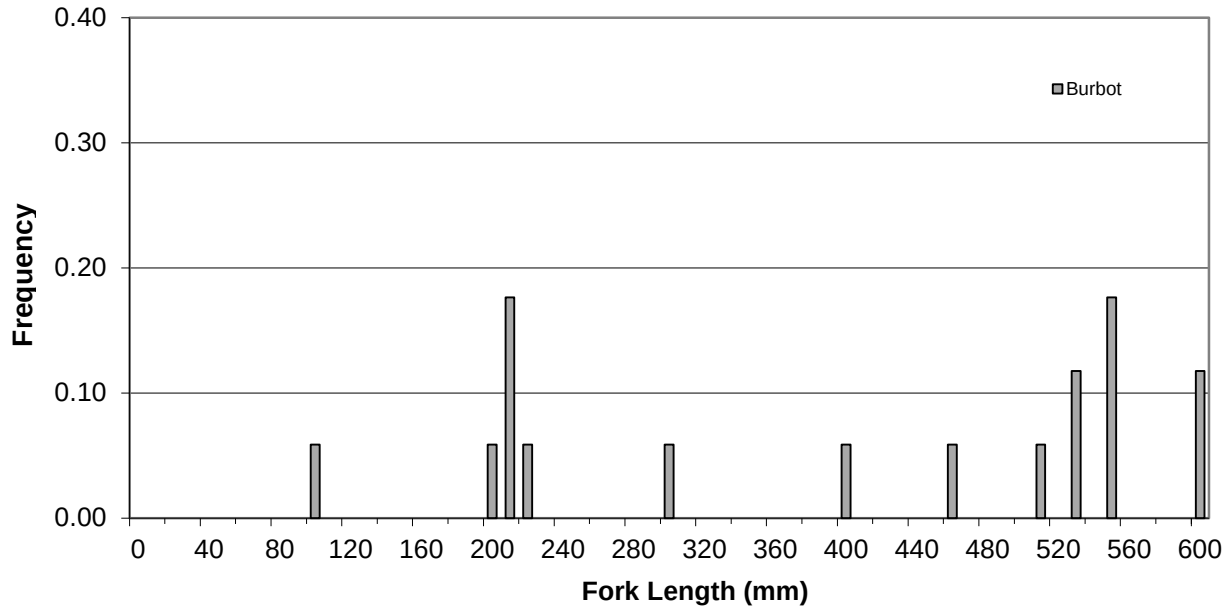

Figure 29.-Tolsona Lake: Length-frequency distribution for burbot captured in fall 2009 (n=17).

Crater Lake

The rainbow trout population was sampled August 16–17, 2010. Water temperature 1 m beneath the surface was 15.4°C. Fourteen rainbow trout (Figure 30) and one slimy sculpin (120 mm) were captured. Two rainbow trout were caught in tangle nets and all other fish were captured in fyke nets. The observed LFD of rainbow trout and stocking records (Appendix A) indicated that most fish were age 2. Fish > 350 mm were most likely age 4 but one fish measuring 510 mm may have been age 6. All captured fish were rotund and appeared to be in good condition. Too few fish were captured to perform statistical analysis, but age-2 fish appeared to be smaller than anticipated (Figure 30).

We're unsure why so few fish were captured in Crater Lake or why age-2 fish were smaller than expected, but we suspect that the number and size of fish were influenced by lake characteristics, fishing pressure, and stockings densities. We define fishing pressure for a lake as total angler effort divided by surface area.

Crater Lake has moderate aquatic vegetation throughout the littoral area. Limnology data collected during April 2010 indicated that winter D.O. was low (0.2 $mg \cdot L^{-1}$ at 0.5 m and 4.0 $mg \cdot L^{-1}$ at the bottom). In August 2010, temperature and D.O. were uniform throughout the water column (approximately 15°C and 12 $mg \cdot L^{-1}$) and were adequate to support rainbow trout.

Harvest likely reduced abundance which contributed to the low catch rates. Angler effort in Crater Lake has been reported in the Statewide Harvest Survey in 2000, 2003, and 2004 but could not be evaluated due to too few respondents. It is difficult to assess fishing effort on small lakes using the Statewide Harvest Survey, but the fact that this lake has appeared in the survey on multiple occasions is a good indication that regular fishing occurs. Even harvesting low numbers of fish on a small lake can quickly deplete the population.

Over stocking may have contributed to the smaller than anticipated size of age-2 fish in Crater Lake. Age-2 fish observed in August 2010 were stocked as fingerlings in 2008 at a density of 615 $fish \cdot ha^{-1}$ (Appendix A). This density is higher than what is typically stocked in other rural or remote lakes. However, all fish captured in 2010 were in very good condition and some fish were larger than 250 mm. This indicates that fingerling stockings can result in a satisfactory catchable product in Crater Lake but ADF&G should restrict the stocking density to no more than 500 $fish \cdot ha^{-1}$. Catchable rainbow trout have not been stocked in this lake, but may be necessary if harvest increases. Because Crater Lake is small it may not be able to meet angler harvest expectations by stocking fingerlings.

Recommendations

- Maintain biennial stockings of 3,000 rainbow trout (2 g or 60 mm FL), target release date early June.
- Stock catchable rainbow trout when they become available from the Ruth Burnett Sport Fish Hatchery when necessary to meet angler harvest expectations. To justify using larger fish, the benefit of an increase in survival rate to catchable size must outweigh the cost of the hatchery resources needed to produce them (Behr and Skaugstad 2011).
- Evaluate the Crater Lake fishery again in 7 years.

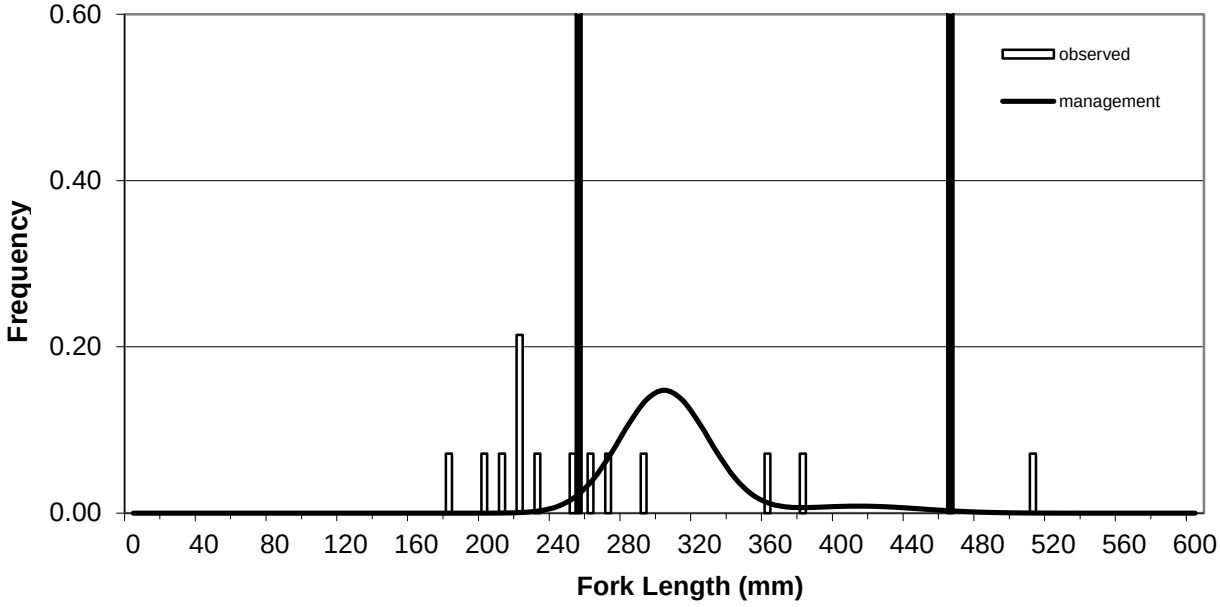

Figure 30.-Crater Lake: Length-frequency distribution for rainbow trout captured in fall 2010 (n=14) plotted with the management population structure.

Tex Smith Lake

Tex Smith Lake was sampled June 9–10, 2010. Water temperature 1 m beneath the surface was 14.8°C. One hundred sixteen rainbow trout were captured in fyke nets and one was captured in a tangle net (Figure 31). All fish appeared to be in good condition and had no external signs of parasite or disease. Larger fish were noticeably more rotund compared to smaller fish. Inspection of the observed LFD of rainbow trout indicated that most captured fish were age 1. We could not identify older age cohorts because multiple life stages had been released into Tex Smith Lake and stockings had occurred on consecutive years. The mean length of captured fish ≥250 mm did not differ from the expected value (Table 27); however, only five fish were captured in this length category. Captured fish <250 mm were age-1 fish and were significantly smaller than management criteria (Table 27 and 28). Management criteria were not achieved for rainbow trout in Tex Smith Lake.

This lake has moderate aquatic vegetation throughout the littoral area. Limnology data collected during April 2010 indicated that winter D.O. was 2-5 mg•L^{-1} in the top 4 m of the water column. D.O. measured during June 2010 was > 10 mg•L^{-1} in the top 3.5 m of the water column. Water temperature was 15.9°C at the surface and 3.8°C at the bottom. Although stocked fish may become stressed due to low D.O. during winter months, we do not believe this is the primary reason for the poor growth observed for age-1 fish.

Age-1 rainbow trout captured during June 2010 were stocked as fingerlings in August 2009. A late summer stocking combined with an early summer sampling event the following year probably explains why age-1 fish had not grown as expected.

High fishing pressure probably explains why only five fish older than age 1 were captured during spring 2010 sampling. Angler effort in Tex Smith Lake has been reported in the Statewide Harvest Survey annually for the past 10 years but could not be evaluated due to too few respondents. Tex Smith Lake is approximately 40 km from the community of Glennallen and is next to the Glenn Highway. Easy access and a reputation for large fish have made this lake a popular destination for anglers.

The current stocking schedule for rainbow trout in Tex Smith Lake is not adequate to meet angler's expectations for harvest given the lake's popularity. Tex Smith Lake has been stocked with rainbow trout since 1968. The lake usually receives catchable rainbow trout but stockings were switched to fingerlings in 2007 due to restrictions on stocking catchable fish from Elmendorf Hatchery.

Recommendations

- □ Discontinue stocking rainbow trout fingerling.
- □ Stock 1,000 triploid catchable rainbow trout (120 g or 213 mm), 500 in late May and 500 in early August, when fish become available from the Ruth Burnett Sport Fish Hatchery.
- □ Evaluate the Tex Smith fishery again in 7 years.

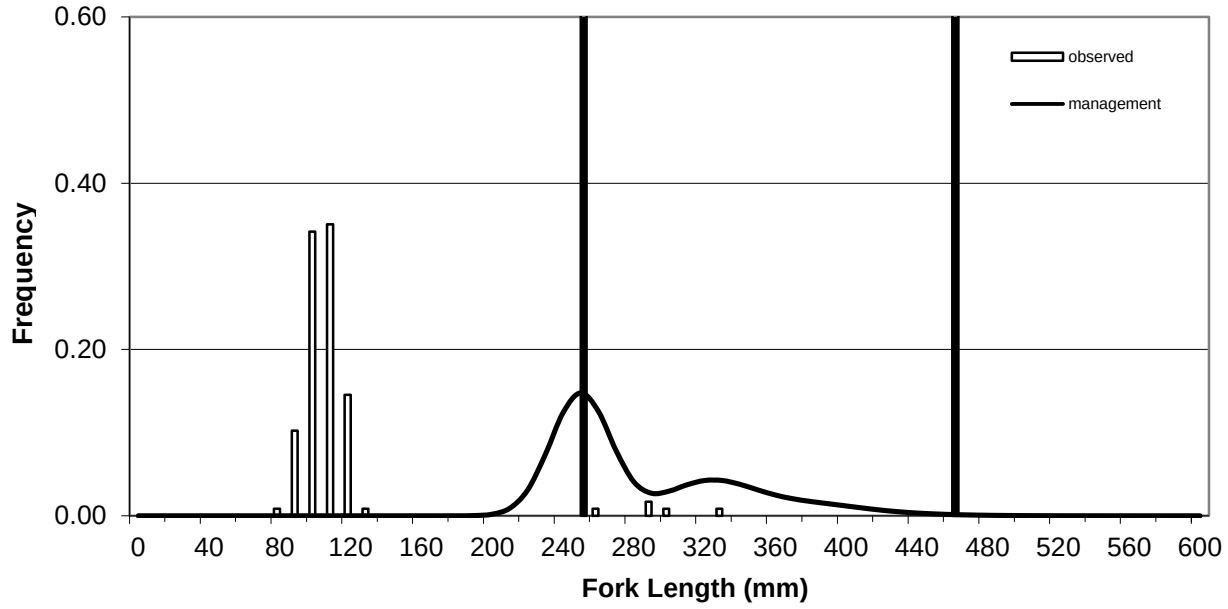

Figure 31.-Tex Smith Lake: Length-frequency distribution for rainbow trout captured in spring 2010 (n=117) plotted with the management population structure.

Table 27.-Tex Smith Lake: Test results by length category for rainbow trout captured in spring 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	112	5	102 mm	290 mm
	(0.96[a])	(0.04[a])	(0.83[b])	(11.16[b])
Management Criteria	28	89	233 mm	301 mm
	(0.24[a])	(0.76[a])		
Test Stat		329.8	-157.9	-1.022
DF		1	111	4
P Value		<0.0001	<0.0001	0.1823

[a] Proportion of catch.

[b] Standard error.

Table 28.-Tex Smith Lake: Test results by age cohort for rainbow trout in spring 2010.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	112 (0.96[a])	0	0	0	0	102 mm (0.83[b])	-	-	-	-
Management Criteria	73 (0.63[a])	29 (0.25[a])	12 (0.10[a])	2 (0.02[a])	0	250 mm	322 mm	375 mm	417 mm	451 mm
Test Stat		-[c]				-178.4	-	-	-	-
DF		-[c]				111	-	-	-	-
P Value		-[c]				<0.0001	-	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort captured. Statistical analysis could not be performed.

SAMPLING FOR BASIC POPULATION INFORMATION

During 2008–2010 stocked waters staff obtained basic population information for 13 lakes.

Tanana Management Area

Dick's Pond is at 6.6 km Coal Mine Road, 42 km south of Delta Junction (Upper Tanana Management Area; Figure 2). Access is by trail. Surface area is 2.0 ha and maximum depth is approximately 11 m. The lake was first stocked with Arctic char fingerlings in 1987. Arctic char captured during fall 2008 sampling were stocked as fingerlings in 2004 or as subcatchables in 2005 and 2007. Managers wanted to know if the current stocking regime resulted in a satisfactory fishery (fish ≥250 mm).

Fourteen Mile Lake is approximately 2 km north of the Denali Highway at km 22.5 (Upper Tanana Management Area; Figure 2). Access is by trail. Surface area is 36.4 ha and maximum depth is approximately 12 m. The lake was first stocked with rainbow trout fingerlings in 1961. Lake trout were stocked once into Fourteen Mile Lake in 1991. Rainbow trout captured during spring 2009 sampling were stocked as fingerlings in 2005 and 2007. Because there is very little aquatic vegetation in this lake, and because lake trout are present, managers wanted to know if rainbow trout stocked as fingerlings resulted in a satisfactory fishery (fish ≥250 mm).

Meadows #1–#6 are off Meadows Road approximately 13 km south of Delta Junction (Upper Tanana Management Area; Figure 2). The lakes are accessible from the Twin Lakes parking area along a 2 km trail. Surface area for the lakes range from 0.81 to 2.02 ha. The Upper Tanana Management Area manager requested the lakes be added to the stocking program in 2005 and 2008. Meadows #1–#4 were first stocked with rainbow trout fingerlings in 2006. Fish captured during 2009 sampling were stocked as fingerlings during 2006 and 2008. Both Meadows #5 and #6 were only stocked in 2008. Managers wanted to know if stocked fish survived the winter and if stockings resulted in satisfactory fisheries (fish ≥250 mm).

Weasel Lake is off the Old Richardson Highway approximately 24 km south of Delta Junction (Upper Tanana Management Area; Figure 2). The lake is accessible by trail. There is a small parking area at the west end of the lake with an 80 m foot path leading to the lake. Surface area is 3.2 ha and maximum depth is approximately 8 m. The lake was first stocked with rainbow trout fingerlings in 1974. Arctic grayling, Arctic char, and Chinook salmon were intermittently stocked into Weasel Lake during the 1980s, and rainbow trout fingerlings are currently stocked on alternate years. Fish captured during 2009 sampling were stocked as fingerlings in 2004 and 2008. Fish were not stocked in 2006 because the access road was washed out. Managers wanted to know if current stockings resulted in a satisfactory fishery (fish ≥250 mm).

Olnes Pond is approximately 29 km north of Fairbanks off the Elliot Highway (Lower Tanana Management Area; Figure 3). Access is by road vehicle along a 1.5 km gravel road just prior to the Chatanika River Bridge. Surface area is 2.0 ha and maximum depth is approximately 12 m. The lake was first stocked with Arctic grayling fry in 1973. Beginning in 1997 Olnes Pond was stocked with catchable Arctic grayling and rainbow trout. In 2007, fingerling rainbow trout were stocked due to a shortage of catchable size fish and because of disease concerns. Managers wanted to know if rainbow trout stocked as fingerlings in 2007 were present during 2009.

Summit Lake is 0.5 km east of the Parks Highway at km 320 (Lower Tanana Management Area; Figure 3). Surface area is 182 ha and maximum depth is 9 m. The lake was first stocked with lake trout in 1989. Lake trout production at ADF&G Sport Fish hatcheries was discontinued in 2000 and

subcatchable/catchable Arctic char were stocked in 2004, 2007, and 2009. The fish populations in Summit Lake were sampled in 2010 because managers wanted to know if Arctic char and lake trout remained in the lake and if these fish grew to a satisfactory catchable size (≥250 mm).

North Chena Pond is within the Chena Lake Recreation Area 5.2 km north of the Chena Lake access Road (Lower Tanana Management Area; Figure 3). Access is by 1.6 km trail on the north side of the Chena Flood Control Project Dam. Surface area is 2.0 ha and maximum depth is approximately 3 m. The lake was first stocked with rainbow trout catchables in 1998. Subcatchable rainbow trout were stocked in 2008 due to a shortage of catchable fish and disease concerns. Managers wanted to know if these fish grew to a satisfactory catchable size (≥250 mm).

Upper Copper/Upper Susitna River Management Area

Dick Lake is east of the Richardson Highway, 5.4 km north of the Meiers Lake Lodge (Upper Copper/Upper Susitna River Management Area; Figure 4). Access is along a narrow side road and short foot path. Surface area is 16.2 ha and maximum depth is approximately 8 m. The lake was first stocked with rainbow trout fingerlings in 1966. Dick Lake has been stocked with Arctic grayling, coho salmon, and Arctic char. Ideally Arctic char catchables should be stocked into Dick Lake on alternate years. In recent years subcatchable and fingerling Arctic char have been stocked due to a shortage of larger fish and disease concerns. Stockings were switched from even to odd year in 2009. Managers wanted to know if stocking smaller fish produced a satisfactory catchable size (≥250 mm).

Objectives

Management Objective 2:	Provide fishery managers and anglers with current information about fish species presence, size range, overall appearance and condition, and document if fish survived the winter in stocked lakes throughout the Tanana River drainage and Upper Copper/Upper Susitna River drainage.
Research Objective 3:	Survey selected stocked lakes to determine fish species present, characterize the size range of the fish captured in fyke nets and tangle nets within 24 to 48 hours of sampling effort per lake, and describe the overall appearance and condition of captured fish.

Methods

The sampling procedure was designed to collect minimal but sufficient data to answer basic questions posed by fishery managers. This approach was appropriate because costs were minimized which allowed the sampling of a large number of fisheries.

Sampling Procedure

Fyke nets and tangle nets were used to sample fish populations. Fyke nets were set for at least one 24 or 48 hour sampling period in each lake in water less than 2 m deep. Because sampling was constrained by time, the sample sizes (number of fish) were not predetermined. At least one fyke net was used per 25 surface acres. However, a minimum of two fyke nets were used per lake. The location and spacing of the nets was left to the crew leader's judgment.

Tangle nets were used to capture fish away from shore in water deeper than 2 m. These nets were used only when a crew was on site. Initially the nets were checked every 30 minutes. The

field crew leader adjusted the time interval between net checks depending on an immediate assessment of the condition of captured fish. Descriptions and methods for using fyke nets and tangle nets were described in the previous section *Sampling for Population Length-Age Structure*. Fish handling and data recording were also similar to that described previously. Water temperature was measured 1 m beneath the surface.

All fish were visually examined for external signs of disease and the presence of parasites. Fish were also subjectively judged to be "thin" if the body volume was less than what an experienced biologist considered normal for the body length.

Data Reduction and Analysis

Sampling was used to document species presence or absence and data were used to generate LFDs for rainbow trout and other game species. When data were sufficient, rainbow trout age cohorts were identified by visual inspection of LFD plots and statistical analyses were performed following the methods outlined in the previous section *Sampling for Population Length-Age Structure*. LFD plots were generated when 10 or more fish of the same species were captured.

Results & Discussion

Tanana Management Area

Dick's Pond

The fish population in Dick's Pond was sampled August 27–28, 2008. Maximum water temperature 1 m beneath the surface was 12.1°C. One hundred sixty-four Arctic char were captured in fyke nets (Figure 32) and most fish appeared thin. Arctic char were stocked in 2007 as age-1 subcatchables and were age 2 at the time of sampling. Fish from stockings prior to 2007 were not present in the sample and few captured fish were ≥250 mm.

Water temperature was recorded at 0.5-1 m intervals throughout the water column at three locations in the lake. Recorded temperature ranged from 11.1 to 12.1°C at all depths and at all sample locations. Although observed temperatures were similar to those reported in the literature to be preferred by Arctic char (Larsson 2005; Mortensen et al. 2007), these temperatures may become stressful to fish when food is limited. Metabolic rate for Arctic char increases significantly with temperature (by approximately 40% for fish reared at 6°C compared to those raised at 1°C (Siikavuopio et al. 2010), and there are no forage fish species available in Dick's Pond. This combination of temperature and limited food may explain why fish appeared "skinny." The number of Arctic char stocked into Dick's Pond may be too high given these conditions.

D.O. recorded during 2008 sampling was > 8 $mg \cdot L^{-1}$ throughout the entire water column at all sample locations. No winter D.O. data were available. Dick's Pond is on Coal Mine Road, a popular year-round recreational destination in the Delta Junction area and the lakes are extensively fished - the larger, older age cohorts may have been harvested.

Recommendations

- Reduce biennial stocking of Arctic char to 375 subcatchables (20 g or 123 mm) on odd years, target release date of early September.
- Measure D.O. in April to determine if conditions during winter exceed the biological tolerances of Arctic char.
- Evaluate the Dick's Pond fishery again in 7 years.

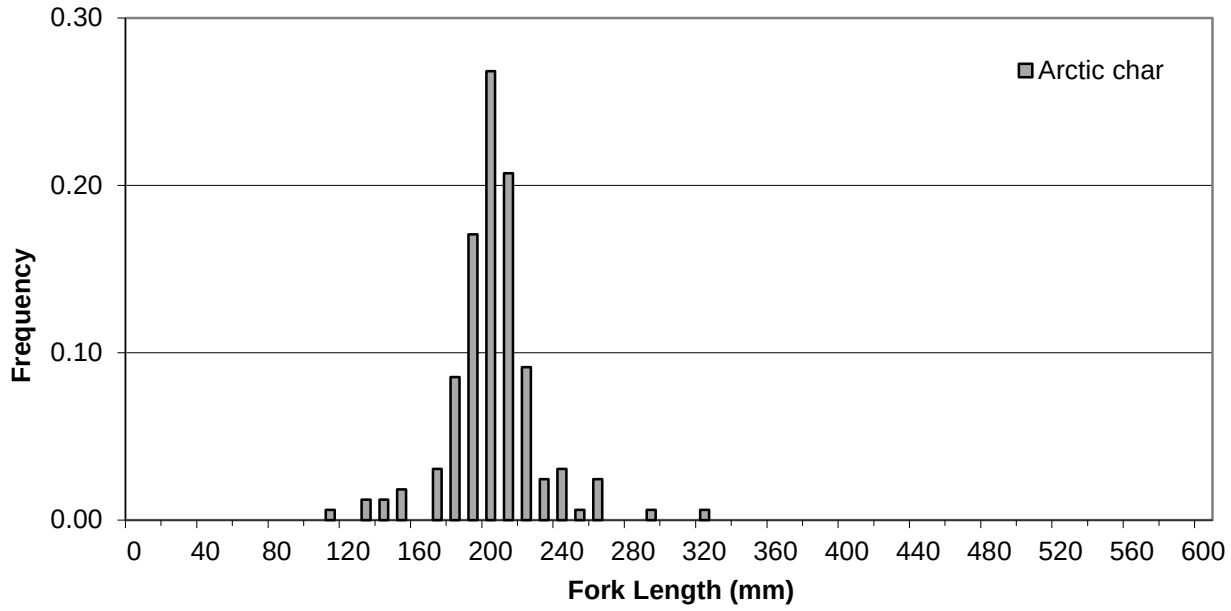

Figure 32.-Dick's Pond: Length-frequency distribution for Arctic char (n=164) captured in fall 2008.

Fourteen Mile Lake

Fish populations were sampled June 24–25, 2009. The maximum temperature recorded during this time was 10.2°C 1 m beneath the surface. Four rainbow trout and five lake trout were captured. Rainbow trout measured 188 mm to 450 mm, and three of the four fish exceeded minimal satisfactory catchable size (≥250 mm) (Figure 33). Age cohorts could not be determined but stocking records indicate that age-2 and age-4 fish should have been present in the lake (Appendix A). Lake trout ranged in size from 78 mm to 226 mm. The presence of a 78 mm lake trout indicates that natural reproduction had occurred. All rainbow trout and lake trout captured in fyke nets appeared to be in good condition and had no external signs of parasite or disease.

Stocking rainbow trout in a lake containing lake trout is not ideal, but local community members have expressed an interest in maintaining a rainbow trout fishery at this lake. Lake trout undoubtedly prey on stocked rainbow trout fingerlings. ADF&G may want to consider stocking larger fingerlings earlier in the year, or consider stocking subcatchables or catchables to reduce mortality due to predation.

Recommendations

- Continue biennial stocking 9,000 rainbow trout (2 g or 60 mm FL), target release date early June.
- Stock larger fingerlings, subcatchables, or catchables if fish become available from the hatchery.
- Evaluate the Fourteen Mile Lake fishery again in 10 years to describe both the lake trout and rainbow trout populations. Increase the use of tangle nets in deep areas of the lake to target lake trout.

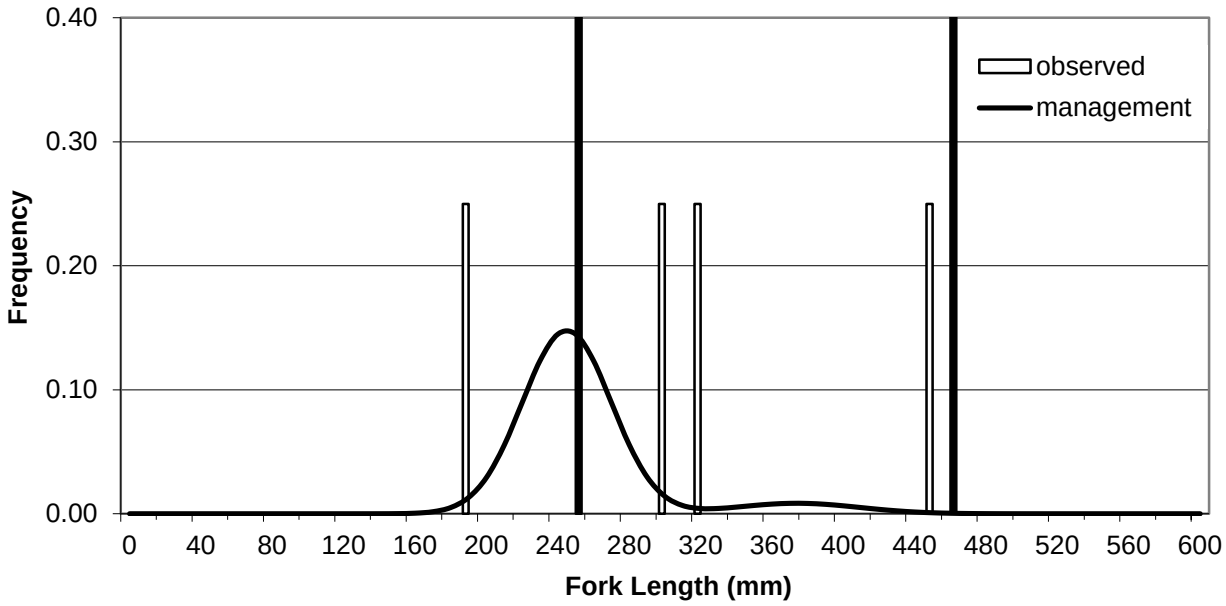

Figure 33.-Fourteen Mile Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=4) plotted with the management population structure.

Meadows #1

The rainbow trout population was sampled June 24–25, 2009. Maximum water temperature was 16.5°C 1 m beneath the surface. Two hundred fifteen rainbow trout were captured and measured. Examination of the observed LFD (Figure 34) and stocking records (Appendix A) indicated that fish were age 1 and age 3. In 2008, while transporting fish to the lake by ATV the supplemental oxygen supply to the transport tank was blocked. Field personnel estimated that only 75 rainbow trout fingerlings were released alive into Meadows #1 (Appendix A). High catch rates of age-1 fish (n=196) in 2009 indicated more fish had obviously recovered.

We captured a sufficient number of rainbow trout to perform statistical analysis. The observed mean lengths for captured fish <250 mm and for age-1 fish were larger than expected (Table 29 and 30). Statistical tests indicated that the mean lengths for fish ≥250 mm and for age-3 fish were smaller than expected (Table 29 and 30). The proportion of fish within specified length categories and identified age cohorts was statistically different compared to expected values but this difference was <0.10 and we did not consider it meaningful to anglers. Despite slightly smaller than anticipated age-3 fish, we considered management criteria achieved for rainbow trout in Meadows #1.

Meadows #1 surface area is 0.8 ha and maximum depth is 8 m. It is deeper compared to other lakes with similar surface area. We observed very little aquatic vegetation and the lake was deep near shore. During population sampling water temperature was <10°C from 2.5 m to 8 m (bottom), and D.O. was 9.1 mg•L^{-1} to 10.8 mg•L^{-1} throughout the upper 5 m of the water column. The presence of multiple age cohorts during spring 2009 sampling indicated that winter D.O.

was sufficient to support fish. Fishing was reported in the 2007 Statewide Harvest Survey but could not be evaluated due to too few respondents.

Overstocking may become an issue in Meadows #1. The stocking density of rainbow trout in Meadows #1 (1,600 fish•ha^{-1}) was three times greater than densities typically used for rural or remote lakes (up to 500 fish•ha^{-1}). Initially, to calculate the number of fish to stock into the lake we relied on a visual estimate of the lake's surface area. A more accurate (and smaller) lake size was determined after mapping the lake in 2009.

Even with possible overstocking, the size of fish exceeded what we expected. When a lake is stocked for the first time there is often an abundance of food available and growth rates are high. Over time, if stocking densities and abundance remain high, food resources will be consumed faster than they can be replenished and growth rates will decline.

Recommendations

- Reduce biennial stockings of rainbow trout fingerlings from 1200 to 400 (2 g or 60 mm FL), target release date early June.
- Evaluate the rainbow trout population in Meadows #1 again in 10 years.

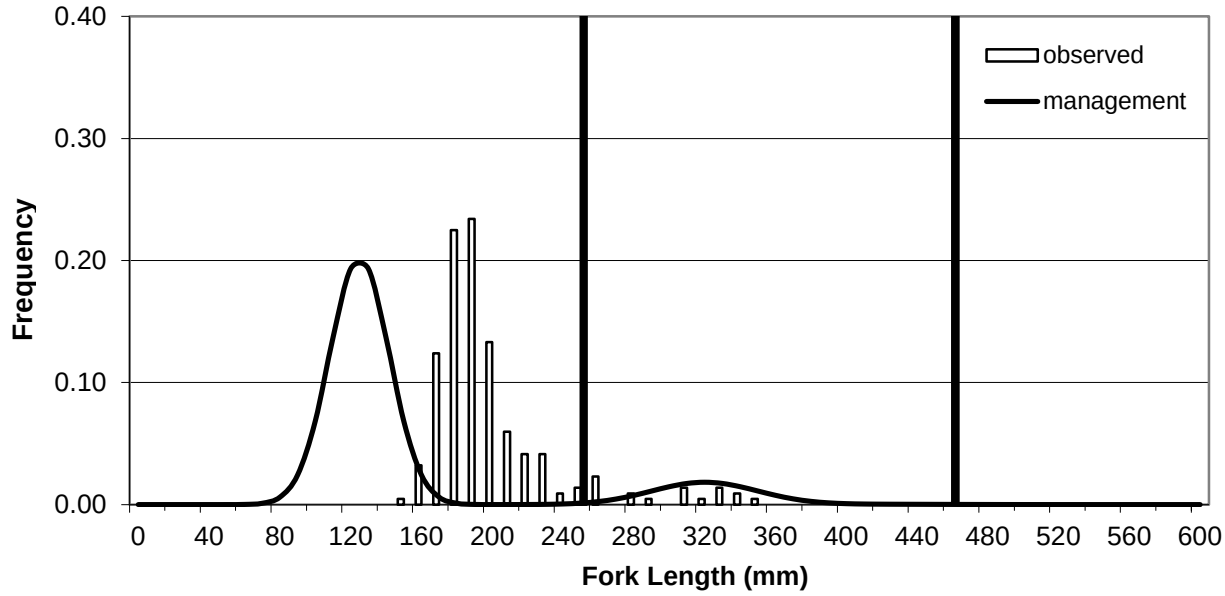

Figure 34.-Meadows #1: Length-frequency distribution for rainbow trout captured in spring 2009 (n=215) plotted with the management population structure.

Table 29.-Meadows #1: Test results by length category for rainbow trout in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	200	15	186 mm	292 mm
	(0.93[a])	(0.07[a])	(1.35[b])	(9.00[b])
Management Criteria	185	30	125 mm	320 mm
	(0.86[a])	(0.14[a])		
Test Stat		8.81	-1.65	-1.76
DF		1	199	14
P Value		0.0030	1.00	0.0038

[a] Proportion of catch.

[b] Standard error.

Table 30.-Meadows #1: Test results by age cohort for rainbow trout in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	196 (0.91[a])	0	19 (0.09[a])	0	0	185 mm (1.25[b])	-	282 mm (8.48[b])	-	-
Management Criteria	185 (0.86[a])	0	30 (0.14[a])	0	0	125 mm	3245 mm	320 mm	374 mm	416 mm
Test Stat		4.76				48.25	-	-4.52	-	-
DF		1				195	-	18	-	-
P Value		0.0291				1.0000	-	0.0001	-	-

[a] Proportion of catch.

[b] Standard error.

Meadows #2

The rainbow trout population was sampled June 2–3, 2009. Maximum water temperature 1 m beneath the surface was 14.3°C. Four hundred and one rainbow trout were captured, of which 175 were measured and the remaining 226 were counted (Figure 35). We measured all fish captured in one fyke net and counted fish that were captured in the other fyke nets of which we measured 10 fish that were exceptionally large or small to document the size range. Examination of the observed LFD (Figure 35) and stocking records (Appendix A) indicated that fish were age 1 and age 3.

In 2008, while transporting fish to the lake by ATV the supplemental oxygen supply to the transport tank was blocked. Field personnel estimated that only 75 rainbow trout fingerlings were released alive into Meadows #2 (Appendix A). Apparently few, if any, fish recovered because very few age-1 fish were captured during 2009 sampling.

Statistical tests indicated that the observed mean length for fish <250 mm was larger than management criteria (Table 31); however, this was primarily a result of age-3 fish being smaller than expected (Table 32 and Figure 35). Age-1 fish and fish ≥250 mm were also smaller than management criteria (Table 31 and 32). The mean length of captured fish in identified age cohorts differed from management criteria by more than 25 mm. The proportion of fish captured within identified age cohorts was also significantly different from management criteria (Table 32). Management criteria for fish captured in Meadows #2 were not achieved.

Meadows #2 is 2.7 surface ha and maximum depth is 8 m. We observed dead submerged bushes along the lake perimeter and bathymetric data showed lake depth increased rapidly not far from shore. Water temperature was <10°C from 2.5 m to 8 m, and D.O. was 9.6 mg•L^{-1} to 6.1 mg•L^{-1} throughout the upper 4 m of the water column. The presence of multiple age cohorts during spring 2009 indicated that winter D.O. was sufficient to support fish.

Meadows #2 is new to the Stocked Fisheries Program (initially stocked in 2006) and has not been reported in the Statewide Harvest Survey. Stocking density of rainbow trout in Meadows #2 was approximately 480 fish•ha^{-1} on alternate years. This density is acceptable for rural or remote lakes but for Meadows #2 it should be reduced. For now, the number of fish in the lake exceeds the capacity of the lake to provide an acceptable population structure. We suspect there is insufficient food for the number of fish. Stocking fewer rainbow trout fingerling will eventually result in a population of fewer fish but larger size at age.

Recommendations

- Reduce biennial stockings of rainbow trout fingerlings from 1275 to 800 (2 g or 60 mm FL), target release date early June.
- Evaluate the rainbow trout population in Meadows #2 again in 10 years.

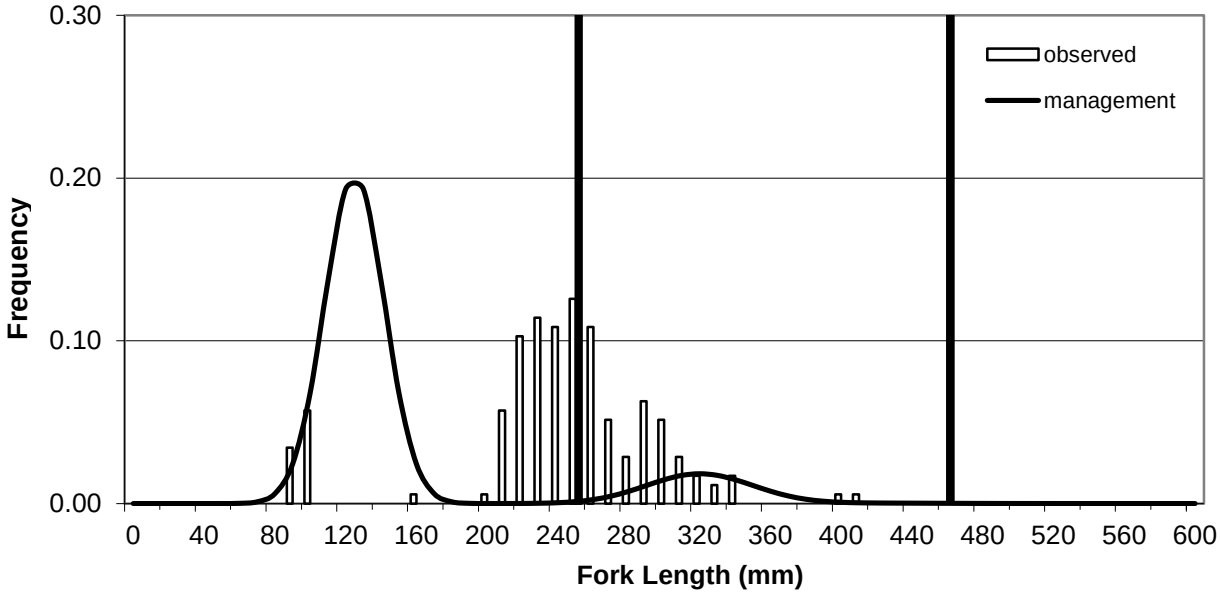

Figure 35.-Meadows #2: Length-frequency distribution for rainbow trout captured in spring 2009 (n=175) plotted with the management population structure.

Table 31.-Meadows #2: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	104	71	205 mm	283 mm
	(0.59[a])	(0.41[a])	(4.98[b])	(3.63[b])
Management Criteria	151	25	125 mm	320 mm
	(0.86[a])	(0.14[a])		
Test Stat		102.6	16.16	-10.06
DF		1	103	70
P Value		<0.0001	1.0000	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 32.-Meadows #2: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	18 (0.10[a])	0	157 (0.90[a])	0	0	101 mm (6.68[b])	-	253 mm (2.88[b])	-	-
Management Criteria	151 (0.86[a])	0	25 (0.14[a])	0	0	125 mm	245 mm	320 mm	474 mm	416 mm
Test Stat		833.2				-3.57	-	-23.36	-	-
DF		1				17	-	156	-	-
P Value		<0.0001				0.0012	-	<0.0001	-	-

[a] Proportion of catch.

[b] Standard error.

Meadows #3

Meadows #3 was sampled June 3–4, 2009. Maximum water temperature 1 m beneath the surface was 14.5°C. No fish were captured. Limnology data collected in late March 2010 indicated that D.O. > 4 mg•L^{-1} down to 3 m, and <1 mg•L^{-1} for the remainder of the water column. D.O. <1 mg•L^{-1} is usually lethal to rainbow trout.

Recommendations

- □ Discontinue stocking.

Meadows #4

Meadows #4 was sampled June 4–5, 2009. Maximum water temperature 1 m beneath the surface was 17.5°C. No fish were captured. Limnology data collected in late March 2010 indicated that D.O. ranged from 1.4 mg•L^{-1} at the surface to 0.13 mg•L^{-1} at the bottom. D.O. <1 mg•L^{-1} is usually lethal to rainbow trout.

Recommendations

- □ Discontinue stocking.

Meadows #5

The rainbow trout population was sampled August 31 through September 1, 2009. Maximum temperature 1 m beneath the surface was 12.5°C. Eighty rainbow trout were captured and measured. Examination of the observed LFD (Figure 36) and stocking records (Appendix A) indicated that fish were age 1.

Sufficient numbers of rainbow trout were captured to perform statistical analysis. The observed mean lengths for fish <250 mm and for age-1 fish were larger than management criteria (Table 33 and 34). The proportions of fish within specified length categories did not meet management criteria (Table 33) because a larger than expected portion of age-1 fish were > 250 mm. Management criteria for fish captured in Meadows #5 were achieved.

Meadows #5 is 2.5 surface ha and maximum depth is 12 m. Bathymetric data indicated that depth increased rapidly from shore. D.O. dropped to less than 1 mg•L^{-1} at 6 m and remained low for the remainder of the water column. A thermocline was present at 5-6 m, and water temperature was well within the thermal tolerance of rainbow trout; however, if surface temperatures were to rise, and deeper cooler waters remained anoxic, stocked fish may have insufficient thermal refuge with adequate D.O.

Meadows #5 is new to the Stocked Fisheries Program (initially stocked in 2006) and has not been reported in the Statewide Harvest Survey. Stocking density of rainbow trout was approximately 470 fish•ha-1. The lake was stocked once prior to sampling in 2009 but alternate year stockings on even years are scheduled to continue. The stocking scheme is acceptable for rural or remote lakes. Growth of stocked fish in Meadows #5 was better than anticipated but fishery performance should be evaluated in 7–10 years after the fishery has had a chance to stabilize. Fish released into a formally fishless lake usually have better than expected initial survival and growth rates that eventually decline if food resources are consumed faster than they are replenished. Future evaluation of the population structure will help managers determine if the current stocking scheme is providing an acceptable fishery.

Recommendations

- □ Continue biennial stockings of 500 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- □ Evaluate the rainbow trout population in Meadows #5 again in 10 years.

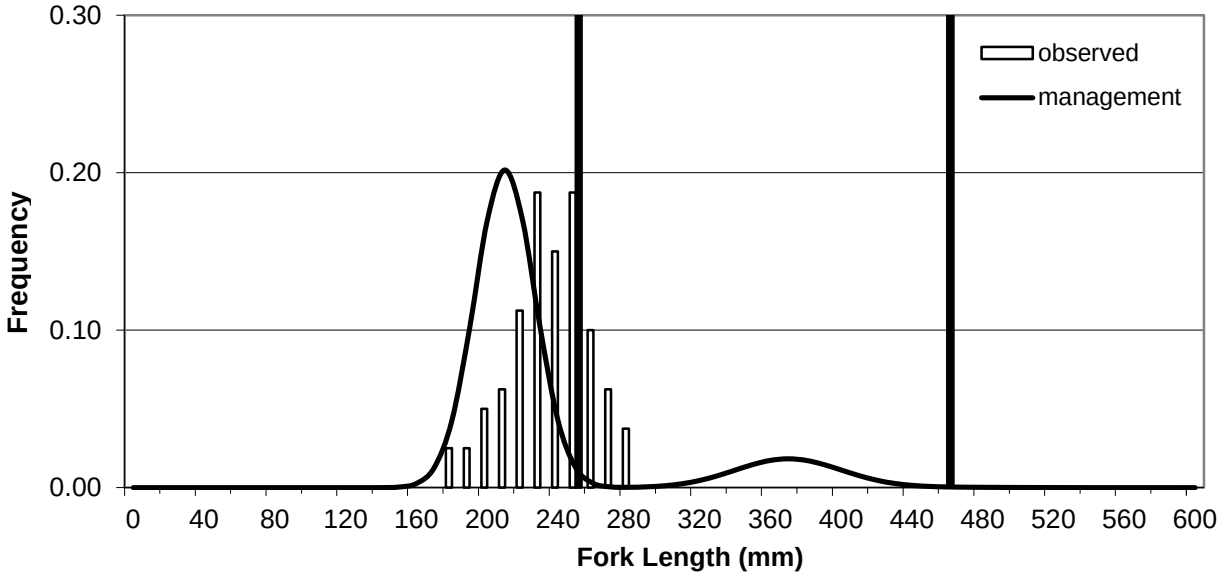

Figure 36.-Meadows #5: Length-frequency distribution for rainbow trout captured in fall 2009 (n=80) plotted with the management population structure.

Table 33.-Meadows #5: Test results by length category for rainbow trout captured in fall 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	59	21	223 mm	259 mm
	(0.74[a])	(0.26[a])	(2.37[b])	(2.05[b])
Management Criteria	67	13	209 mm	358 mm
	(0.84[a])	(0.16[a])		
Test Stat		6.25	5.95	-48.14
DF		1	58	20
P Value		0.0124	1.0000	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 34.-Meadows #5: Test results by age cohort for rainbow trout captured in fall 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	80 (1.00[a])	0	0	0	0	233 mm (2.55[b])	-	-	-	-
Management Criteria	69 (0.86[a])	0	11 (0.14[a])	0	0	210 mm	300 mm	370 mm	410 mm	450 mm
Test Stat		-[c]				8.84	-	-	-	-
DF		-[c]				79	-	-	-	-
P Value		-[c]				1.0000	-	-	-	-

[a] Proportion of catch.

[b] Standard error.

[c] Only one age cohort captured. Statistical analysis could not be performed.

Meadows #6

Meadows #6 was sampled August 31–Septemper 1, 2009. Maximum water temperature 1 m beneath the surface was 11.9°C. No fish were captured. In late March 2010, D.O. ranged from 2.6 mg•L^{-1} at the surface to 1.5 mg•L^{-1} at the bottom. This range is usually lethal to rainbow trout.

Recommendations

- □ Discontinue stocking.

Weasel Lake

Fish populations in Weasel Lake were sampled June 10–11, 2009. Maximum water temperature 1 m beneath the surface was 15.0°C. Forty seven rainbow trout (Figure 37) and five Arctic char (111-161 mm) were captured and measured. All fish were captured in fyke nets except for two Arctic char and one rainbow trout that were caught in tangle nets. Two additional Arctic char were captured in tangle nets but escaped before they could be measured. We estimated that these fish were approximately 400 mm. Examination of the observed LFD of rainbow trout (Figure 37) and stocking records (Appendix A) indicated that rainbow trout were age 1 and age 5. Arctic char were last stocked into Weasel Lake in 1988. The presence of small (111-161 mm) and large (approximately 400 mm) Arctic char indicates that natural reproduction has occurred.

Sufficient numbers of rainbow trout were captured to perform statistical analysis. The observed mean length for rainbow trout <250 mm and for age-1 fish were significantly smaller than management criteria (Table 35 and 36). The observed mean length for fish ≥250 mm was larger than anticipated; however, these fish were age 5 and smaller than management criteria for this cohort (Table 36). It is also important to note that only five age-5 fish were captured and it is difficult to draw conclusions based on this limited sample size. Management criteria for rainbow trout in Weasel Lake were not achieved. We don't know why rainbow trout in Weasel Lake were smaller than expected but we suspect that fish size was influenced by lake characteristics and stocking densities.

Limnology data collected during fish sampling indicated that D.O. and temperature were within the tolerance for rainbow trout, but D.O. dropped below 1 mg•L^{-1} in the bottom 2 m of the lake. We observed limited aquatic vegetation in the littoral area surrounding the lake and bathymetric data indicated that approximately 40% of the lake was <2 m in depth.

We do not believe that harvest is significantly impacting the rainbow trout population in Weasel Lake at this time. Weasel Lake is accessible only by trail and is located on military land which requires a permit to access. The lake has been stocked since 1974 and is occasionally reported in the Statewide Harvest Survey. Angling was reported in 1998, 1999, and 2006 but there were too few respondents to evaluate fishing effort. Age-5 fish were still present in Weasel Lake, and typically, older larger fish will be absent in populations that are heavily fished.

The stocking density of rainbow trout for Weasel Lake was approximately 250 fish•ha^{-1}, which is well below the stocking density recommended for rural or remote lakes. Stocking records show 1,600 rainbow trout fingerlings were historically stocked into Weasel Lake on alternate years (494 fish•ha^{-1}), and occasionally annually. This number of fish may have resulted in too large a population that likely depleted available resources in the lake. Fewer fish have been stocked since 2004. In 2010 larger fish were available for stocking (6 g fish instead of the 1-2 g fish that are typically stocked) and the number of fish stocked was reduced even further because we

expected higher survival rates. The number of fingerling rainbow trout stocked into Weasel Lake should remain low and larger (> 2 g) rainbow trout fingerlings should be stocked whenever possible. Fishery performance should be evaluated in 7–10 years to determine if fishery management criteria can be achieved.

Recommendations

- □ Continue biennial stockings of 400-800 rainbow trout fingerlings (2 g or 60 mm FL), target release date early June.
- □ Stock larger fingerlings or subcatchables if fish become available from the hatchery.
- □ Evaluate the rainbow trout population in Weasel Lake again in 10 years.

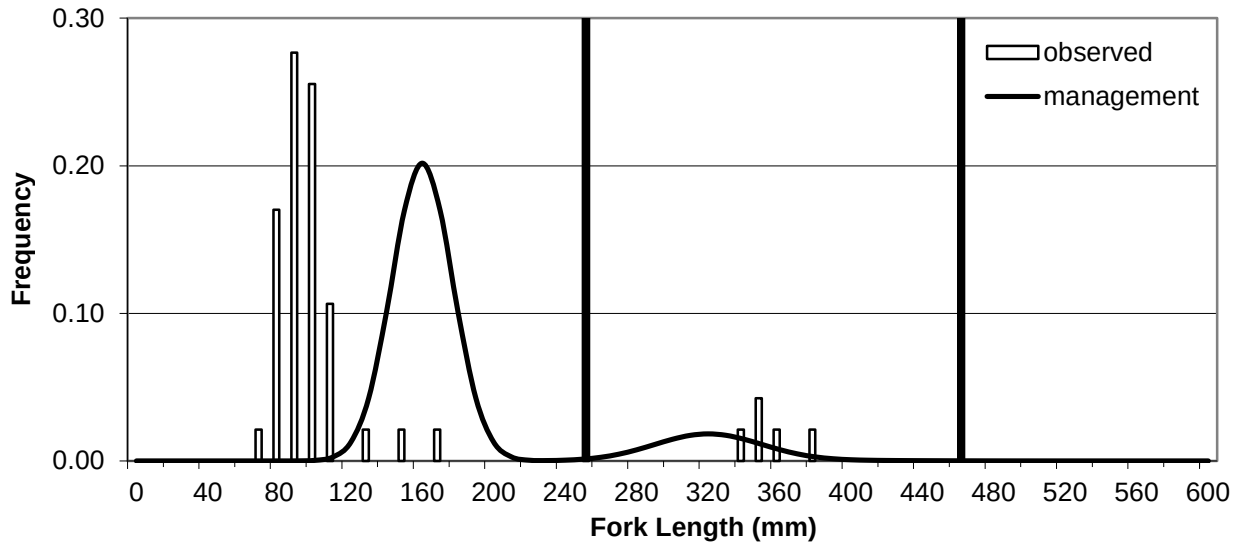

Figure 37.-Weasel Lake: Length-frequency distribution for rainbow trout captured in spring 2009 (n=47) plotted with the management population structure. The management population structure was generated using preferred stocking schemes.

Table 35.-Weasel Lake: Test results by length category for rainbow trout captured in spring 2009.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	42	5	93 mm	353 mm
	(0.89[a])	(0.11[a])	(2.80[b])	(6.45[b])
Management Criteria	40	7	125 mm	321 mm
	(0.86[a])	(0.14[a])		
Test Stat		0.44	-11.43	4.90
DF		1	41	4
P Value		0.5066	<0.0001	0.9960

[a] Proportion of catch.

[b] Standard error.

Table 36.-Weasel Lake: Test results by age cohort for rainbow trout captured in spring 2009.

	Relative Abundance (χ2 test)					Mean Length (t test)				
	age-1	**age-2**	**age-3**	**age-4**	**age-5**	**age-1**	**age-2**	**age-3**	**age-4**	**age-5**
Observed	42 (0.89[a])	0	0	0	5 (0.11[a])	93 mm (2.80[b])	-	-	-	353 (6.45[b])
Management Criteria	40 (0.86[a])	0	7 (0.14[a])	0	0	125 mm	245 mm	320 mm	374 mm	416 mm
Test Stat		-[c]				-11.43	-	-	-	-9.82
DF		-[c]				41	-	-	-	4
P Value		-[c]				<0.0001	-	-	-	0.0003

[a] Proportion of catch.

[b] Standard error.

[c] Alternate year stocking were not maintained. Statistical analysis could not be performed.

Olnes Pond

Fish populations in Olnes Pond were sampled June 18–19, 2009. Maximum water temperature 1 m beneath the surface was 17.2°C. No stocked fish were captured. We did capture longnose suckers, lake chub, and whitefish *Coregonus spp*. Because native species were present it is unlikely that stocked fish died due to insufficient D.O. during winter. Olnes Pond is adjacent to the Chatanika River which on rare occasion flows into the pond during extreme high water events. Stocked rainbow trout probably escape the pond during such events. Because Olnes Pond is a very popular fishery we recommend stocking fish multiple times during summer to maintain reasonable fishing opportunity. Only sterile fish should be stocked to minimize interaction with wild populations if fish escape to the river.

Recommendations

- □ Stock 700 rainbow trout catchables (180 g or 240 mm FL) once in early June and again in late July or early August.
- □ Stock 500 Arctic grayling catchables (120 g or 210 mm FL), target release date early June.
- □ Evaluate the Olnes Pond fishery again in 7 years to describe both the rainbow trout and Arctic grayling populations.

Summit Lake

Fish populations were sampled June 22–24, 2010. Maximum water temperature 1 m beneath the surface was 14.5°C. No stocked fish were captured during sampling. We did capture 15 Arctic grayling (Figure 38), 46 humpback whitefish *Coregonus pidschian* (Figure 39), 5 burbot (103-198 mm TL), 10 round whitefish *Prosopium cylindraceum* (Figure 40), and 6 slimy sculpin (35-65 mm). Summit Lake seasonally flows into several adjacent lakes. Arctic char stocked as subcatchables may have escaped from the lake during a high water event and may have been prey for burbot. Because stocked fish were not captured during sampling, and because other sport fish species are present in the lake naturally, we recommend discontinuing fish stockings into Summit Lake because past stocking didn't provide a fishery. Wild Arctic grayling and burbot in the lake can provide a sport fishery.

Recommendations

- □ Discontinue stocking Summit Lake.

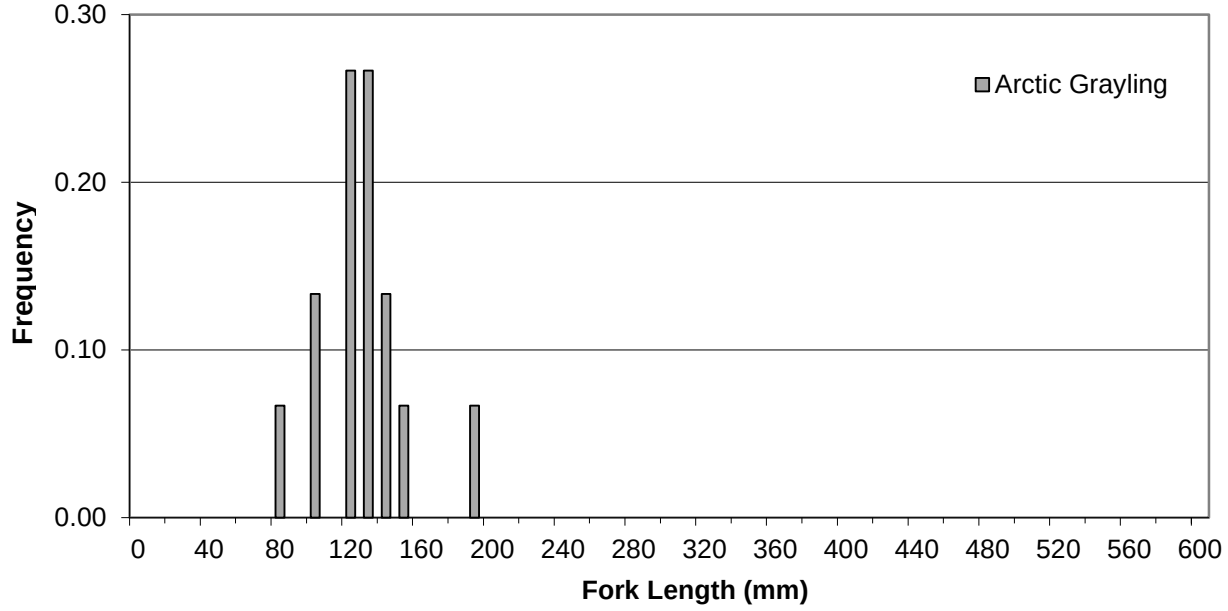

Figure 38.-Summit Lake: Length-frequency distribution for Arctic grayling captured in spring 2010 (n=15).

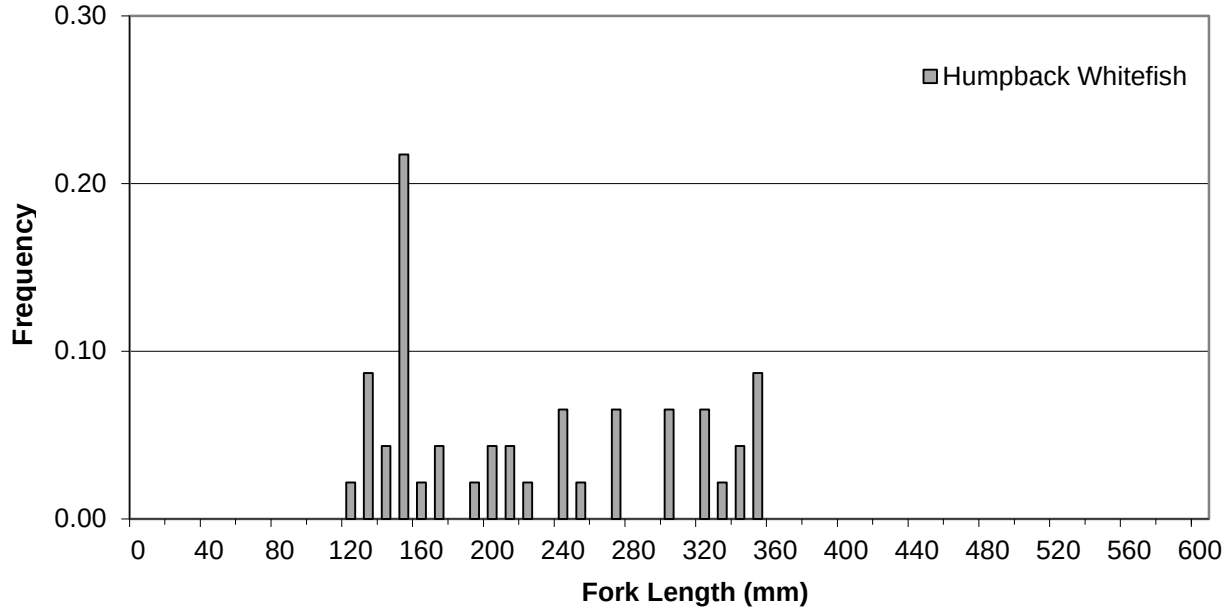

Figure 39.-Summit Lake: Length-frequency distribution for humpback whitefish captured in spring 2010 (n=46).

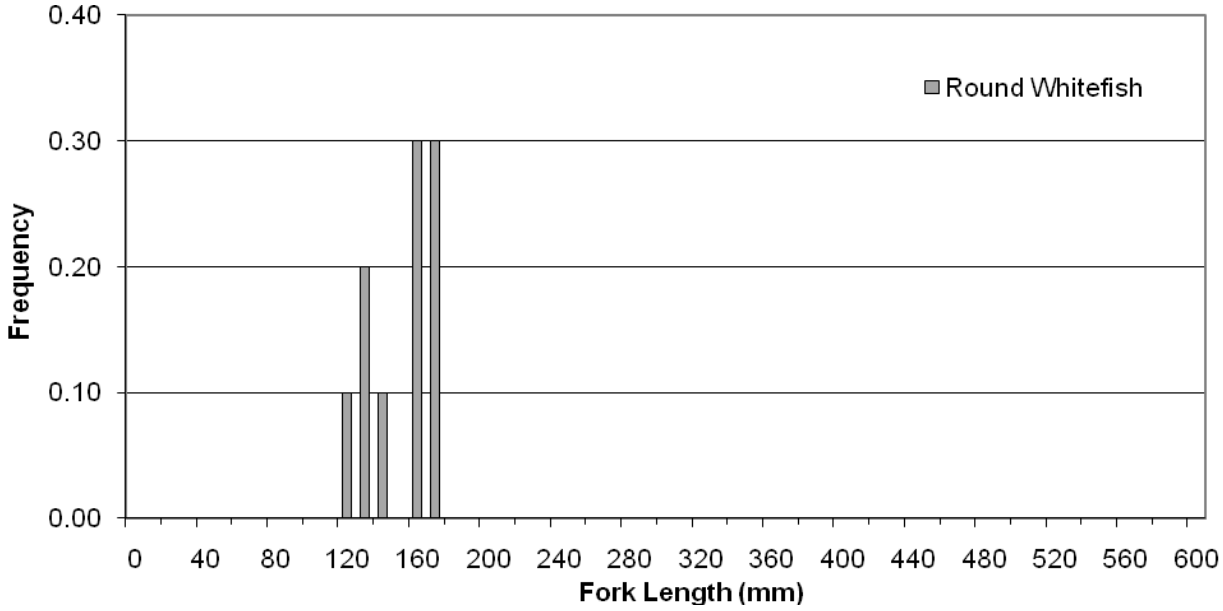

Figure 40.-Summit Lake: Length-frequency distribution for round whitefish captured in spring 2010 (n=10).

North Chena Pond

Fish populations were sampled May 27–28, 2010. Water temperature 1 m beneath the surface was 17.5-19.7°C. Eighteen rainbow trout were captured (Figure 41) along with approximately 1,000 longnose suckers, from which a subsample of 60 fish were measured (Figure 42). Fish were captured in fyke nets and tangle nets and appeared to be in good condition. Age cohorts for rainbow trout could not be determined; different age cohorts were stocked in 2008 (age 1 and age 2) and 2009 (age 2) (Appendix A) and a similar size in 2010. We were able to proceed with our statistical analysis on captured rainbow trout.

The observed mean length for rainbow trout <250 mm did not resemble management criteria (Table 37). Of the ten fish in this size category, 9 had been stocked 10 days prior to sampling. The mean length for fish ≥250 mm did not differ from expected values; however, only eight fish were captured in this length category (Table 37). The sample size is too small to make reliable conclusions. The proportion of fish captured within specified length categories did not resemble management criteria (Table 37). Although few fish were captured at North Chena Pond, we concluded that management criteria were achieved because about half of the catch was ≥250 mm.

Water temperature during the sampling event was > 15°C down to 2 m. Because the lake is shallow, thermal refuge may not be available during hot summer months. In midsummer, aquatic vegetation is present throughout most of the lake. During winter, decaying vegetation depletes D.O. which may stress or kill rainbow trout. Winter water quality data were not available for North Chena Pond but this information is needed to help us predict how various habitat conditions such as depth, decomposition and D.O. vary naturally and interact to affect fish survival.

We believe that we caught few fish because most of the rainbow trout population had been harvested. North Chena Pond is relatively close to Chena Lakes, a very popular recreation area near the community of North Pole. Additionally, youth attending the Alaska Conservation Camp have fished at North Chena Pond during the month of June since 2007. Fishing in North Chena Pond was reported in the 2000 Statewide Harvest Survey but could not be evaluated due to too few respondents.

The current stocking scheme is providing an adequate fishery, but if annual harvest increases, ADF&G may need to stock more catchable size fish to meet angler expectations. We recommend stocking Arctic grayling to increase species diversity and make the fishery attractive to more anglers.

Recommendations

- Stock 500 rainbow trout catchables (180 g or 240 mm FL) annually, target release date early June.
- Stock 200 Arctic grayling catchables (120 g or 210 mm FL), target release date early June.
- Evaluate the rainbow trout and Arctic grayling populations again in 10 years.
- Measure D.O. in March or early April to determine if the concentration is adequate to support fish.

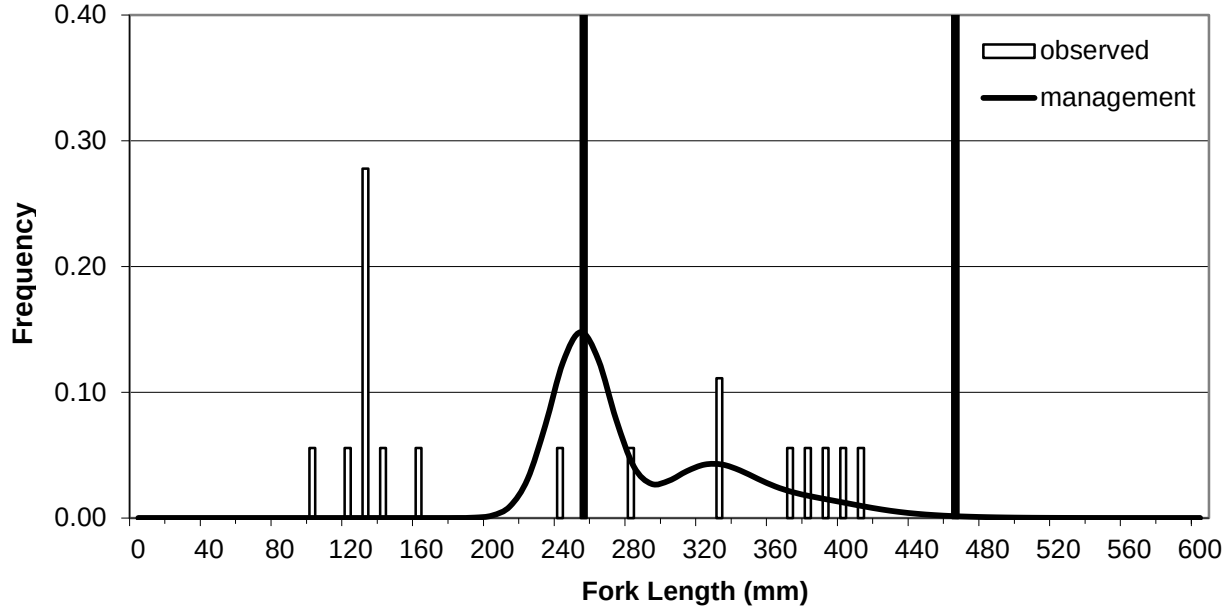

Figure 41.-North Chena Pond: Length-frequency distribution for rainbow trout captured in spring 2010 (n=18) plotted with the management population structure.

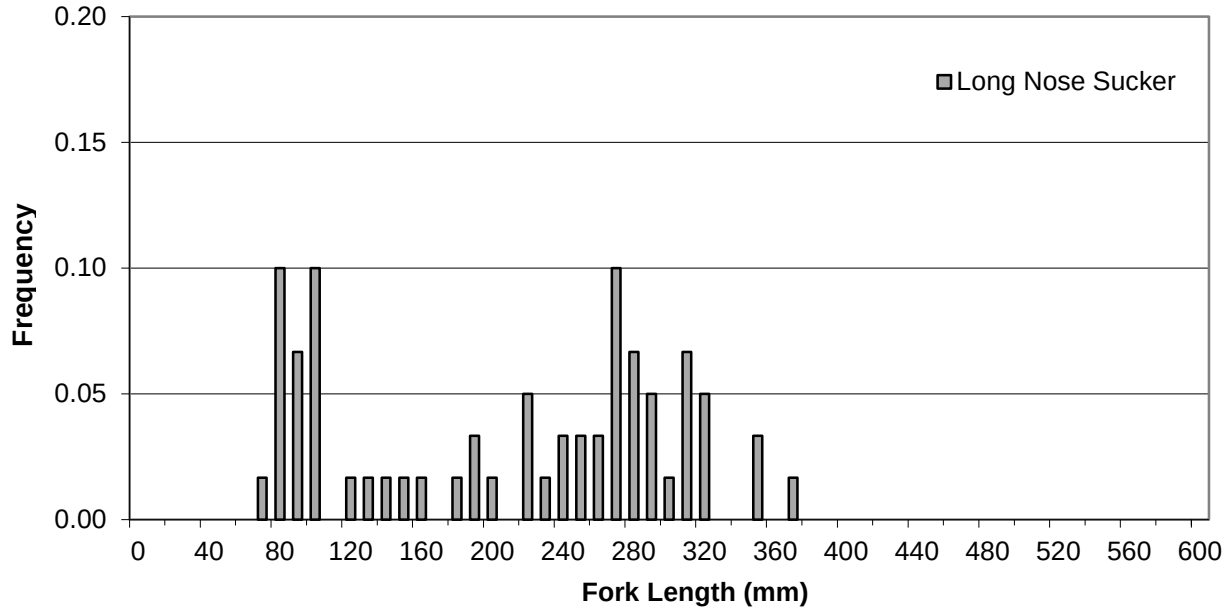

Figure 42.-North Chena Pond: Length-frequency distribution for longnose sucker captured in spring 2010 (n=60).

Table 37.-North Chena Pond: Test results by length category for rainbow trout captured in spring 2010.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	10	8	140 mm	359 mm
	(0.56[a])	(0.44[a])	(12.01[b])	(15.27[b])
Management Criteria	4	14	223 mm	301 mm
	(0.24[a])	(0.76[a])		
Test Stat		9.83	-6.96	3.76
DF		1	9	7
P Value		0.0017	<0.0001	0.9965

[a] Proportion of catch.

[b] Standard error.

Upper Copper/Upper Susitna River Management Area

Dick Lake

The Arctic char population was sampled June 9–11, 2010. Water temperature was 14.3-15.4°C 1 m beneath the surface. Eleven Arctic char (Figure 43) and 11 slimy sculpin (Figure 44) were captured in fyke nets and tangle nets and appeared to be in good condition. Stocking records indicate that fish were age 1 and age 3 at the time of sampling in 2010.

Fishing effort, catch, and harvest for Dick Lake is usually reported annually in the Statewide Harvest Survey, so our low catch rates were probably due to harvest. Arctic char catchables are the preferred stocking product for Dick Lake but in recent years subcatchables have been stocked (Appendix A) due to limited numbers of catchable size fish. Subcatchable Arctic char grow to a satisfactory size (≥250 mm FL) after a few years in the lake.

Recommendations

- □ Continue stocking 500 Arctic char subcatchables on alternate years (20 g or 120 mm FL), target release date early September.

  Or

- □ Stock catchable Arctic char when available (120 g or 210 mm FL), target release date early June.
- □ Evaluate the Arctic char population again in 10 years.

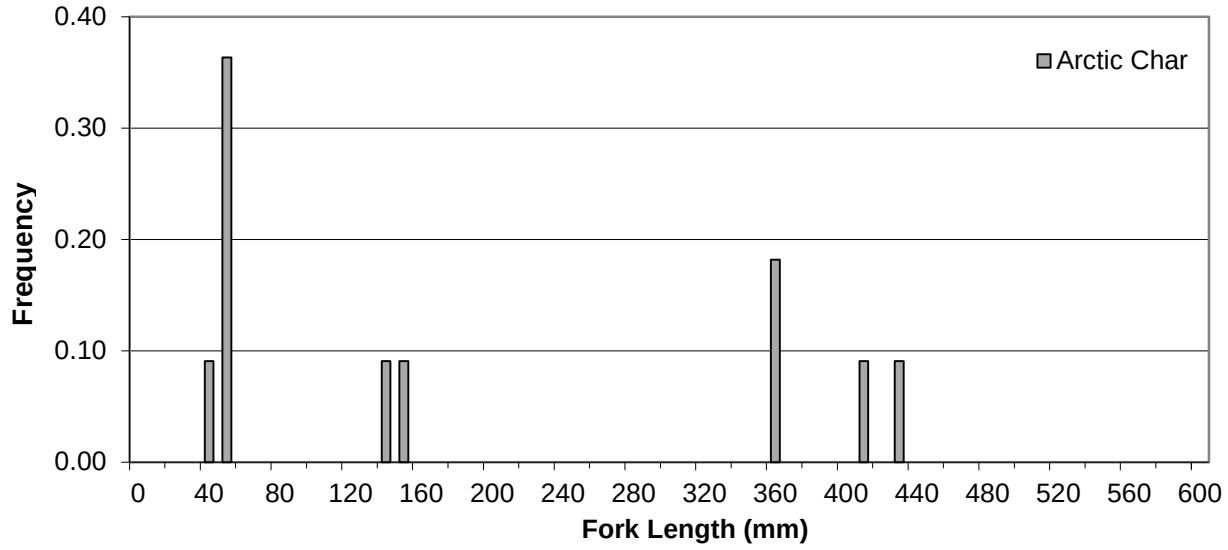

Figure 43.-Dick Lake: Length-frequency distribution for Arctic char captured in spring 2010 (n=11).

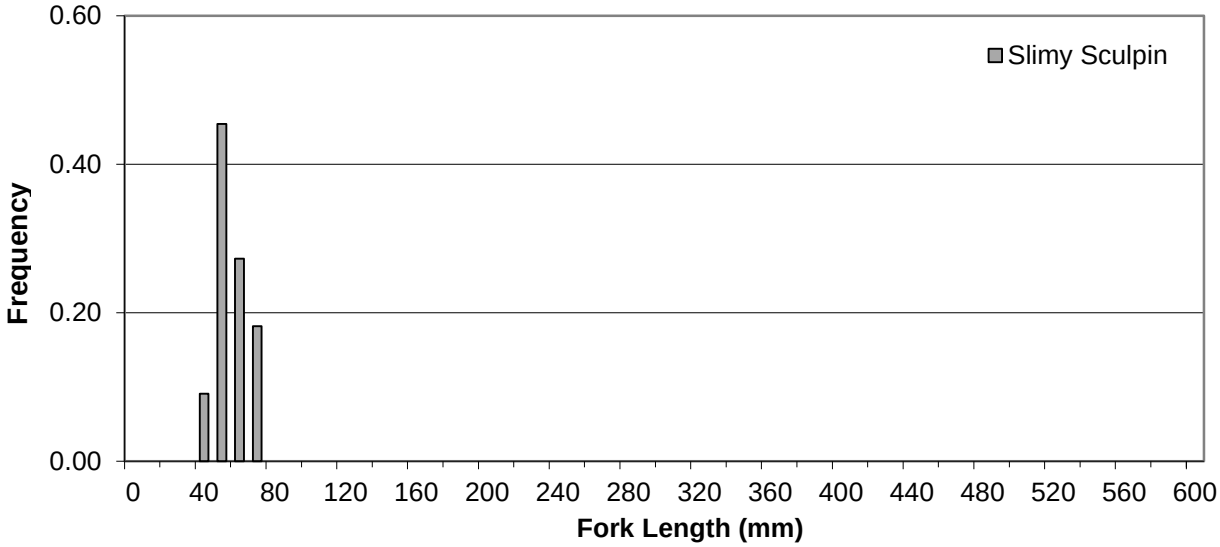

Figure 44.-Dick Lake: Length frequency distribution for slimy sculpin captured in spring 2010 (n=11).

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APPENDIX A

STOCKING HISTORIES FOR FISH POPULATIONS SAMPLED IN 2008–2010

Appendix A.–Stocking histories for fish populations sampled in 2008–2010.

Lake	Species	Date	Number	FL (in)	FL (mm)	Lifestage
Bluff Cabin Lake	RT	7/14/2004	7,000	2.0	52	F
Bluff Cabin Lake	RT	8/28/2006	6,614	2.1	53	F
Bluff Cabin Lake	RT	8/19/2008	7,000	2.1	52	F
Coal Mine #5 Lake	RT	8/2/2004	2,000	1.9	48	F
Coal Mine #5 Lake	RT	8/18/2004	540	6.3	160	S
Coal Mine #5 Lake	RT	8/30/2006	2,000	2.1	52	F
Coal Mine #5 Lake	RT	8/26/2008	2,000	2.5	64	F
Coal Mine #5 Lake	RT	8/26/2008	1,000	2.0	50	F
Craig Lake	RT	8/20/2003	2,000	2.1	54	F
Craig Lake	RT	7/14/2004	2,000	2.0	52	F
Craig Lake	RT	8/21/2006	1,350	2.0	50	F
Craig Lake	RT	8/12/2008	2,000	1.9	47	F
Crater Lake	RT	8/9/2004	3,193	2.1	54	F
Crater Lake	RT	9/1/2006	3,000	2.1	53	F
Crater Lake	RT	8/20/2008	4,000	2.0	50	F
Dick Lake	AC	5/19/2005	2,014	8.8	224	C
Dick Lake	AC	8/23/2007	3,051	2.9	74	S
Dick Lake	AC	8/14/2009	3,000	2.9	72	F
Dick’s Pond	AC	9/4/2002	588	3.7	94	S
Dick’s Pond	AC	8/19/2004	375	2.8	70	F
Dick’s Pond	AC	8/24/2005	375	3.7	93	S
Dick’s Pond	AC	8/28/2007	375	3.0	77	S
Doc Lake	RT	8/17/2004	506	2.3	58	F
Doc Lake	RT	8/30/2006	500	2.1	52	F
Doc Lake	RT	8/14/2008	500	2.2	56	F
Fourteen Mile Lake	RT	9/13/2005	8,941	2.4	62	F
Fourteen Mile Lake	RT	8/23/2007	9,000	2.0	52	F
Ghost Lake	AC	8/19/2004	300	2.8	70	F
Ghost Lake	RT	8/17/2004	1,012	2.3	58	F
Ghost Lake	AC	8/24/2005	300	3.7	93	S
Ghost Lake	AC	8/30/2006	300	3.5	89	S
Ghost Lake	RT	8/30/2006	1,000	2.1	52	F
Ghost Lake	RT	8/14/2008	482	2.2	56	F

-continued-

Appendix A.–Page 2 of 4.

Lake	Species	Date	Number	FL (in)	FL (mm)	Lifestage
Hidden Lake (Tok)	RT	8/20/2003	4,000	2.2	57	F
Hidden Lake (Tok)	RT	8/16/2007	4,000	1.9	47	F
Kathleen Lake	RT	9/5/2007	5,000	2.4	60	F
Ken's Pond	AC	9/4/2002	588	3.7	94	S
Ken's Pond	RT	8/14/2002	829	2.1	54	F
Ken's Pond	AC	8/19/2004	375	2.8	70	F
Ken's Pond	RT	8/2/2004	1,000	1.9	48	F
Ken's Pond	AC	8/24/2005	375	3.7	93	S
Ken's Pond	RT	9/5/2006	1,000	2.1	52	F
Ken's Pond	AC	8/28/2007	375	3.0	77	S
Lost Lake	KS	9/20/2004	2,000	7.6	193	C
Lost Lake	RT	5/25/2004	4,204	8.4	214	C
Lost Lake	RT	8/26/2004	1,006	9.8	248	C
Lost Lake	KS	9/22/2005	2,311	8.1	206	C
Lost Lake	RT	5/13/2005	3,179	8.3	211	C
Lost Lake	RT	5/25/2006	1,475	10.3	262	C
Lost Lake	AC	8/23/2007	1,008	3.7	95	S
Lost Lake	RT	8/16/2007	20,067	1.8	46	F
Lost Lake	RT	7/2/2008	11,654	3.6	92	F
Lost Lake	AC	8/14/2009	2,018	2.9	72	F
Lost Lake	GR	5/26/2009	2,541	4.7	119	F
Lost Lake	RT	8/14/2009	52	9.4	239	B
Lost Lake	RT	9/3/2009	20,000	2.3	58	F
Meadows Road #1	RT	9/11/2006	1,275	2.2	56	F
Meadows Road #1	RT	8/14/2008	75	2.2	56	F
Meadows Road #2	RT	9/11/2006	1,275	2.2	56	F
Meadows Road #2	RT	8/14/2008	76	2.2	56	F
Meadows Road #3	RT	9/11/2006	1,275	2.2	56	F
Meadows Road #3	RT	8/14/2008	76	2.2	56	F
Meadows Road #4	RT	9/11/2006	1,275	2.2	56	F
Meadows Road #4	RT	8/14/2008	386	2.2	56	F
Meadows Road #5	RT	8/14/2008	471	1.8	45	F
Meadows Road #6	RT	8/14/2008	190	1.8	45	F
Meadows Road #6	RT	8/14/2008	121	2.2	56	F

-continued-

Lake	Species	Date	Number	FL (in)	FL (mm)	Lifestage
Monte Lake	RT	8/3/2001	18,000	1.9	47	F
Monte Lake	RT	7/14/2004	15,000	2.0	52	F
Monte Lake	RT	8/21/2006	10,000	2.0	50	F
Nickel Lake	GR	8/20/2003	500	2.1	53	F
Nickel Lake	AC	8/19/2004	100	2.8	70	F
Nickel Lake	GR	8/2/2004	1,000	1.7	42	F
Nickel Lake	RT	5/28/2004	600	8.7	222	C
Nickel Lake	RT	8/2/2004	1,000	1.9	48	F
Nickel Lake	GR	8/16/2005	1,000	2.5	63	F
Nickel Lake	AC	8/30/2006	100	3.4	86	S
Nickel Lake	GR	8/30/2006	900	2.4	62	F
Nickel Lake	RT	9/5/2006	1,000	2.1	53	F
Nickel Lake	AC	8/14/2008	100	3.4	86	S
Nickel Lake	GR	8/14/2008	1,000	2.2	55	F
Nickel Lake	RT	8/14/2008	760	1.8	45	F
North Chena Pond	RT	6/22/2004	450	8.6	218	C
North Chena Pond	RT	6/7/2007	429	6.2	157	C
North Chena Pond	RT	5/21/2008	500	7.1	181	C
North Chena Pond	RT	5/22/2008	500	6.0	152	C
North Chena Pond	RT	5/26/2009	500	5.4	138	C
Olnes Pond	RT	6/22/2004	977	8.3	211	C
Olnes Pond	RT	8/21/2007	1,000	2.0	50	F
Rapids Lake	RT	8/2/2004	1,000	1.9	49	F
Rapids Lake	RT	8/28/2006	1,000	1.9	48	F
Rapids Lake	RT	8/19/2008	1,500	2.0	51	F
Robertson #2 Lake	RT	7/14/2004	3,000	2.0	52	F
Robertson #2 Lake	RT	8/21/2006	500	2.0	50	F
Robertson #2 Lake	RT	8/12/2008	3,000	1.9	47	F
Rockhound Lake	RT	8/17/2004	601	2.3	58	F
Rockhound Lake	RT	8/30/2006	600	2.1	52	F
Rockhound Lake	RT	8/14/2008	601	2.2	56	F
Strelna Lake	RT	8/12/2003	15,006	1.9	48	F
Strelna Lake	SS	6/22/2004	17,147	2.5	63	F
Strelna Lake	RT	9/5/2007	20,000	2.4	60	F
Strelna Lake[a]	RT	6/1/2008	1,000	8.8	223	C

[a] Fish transferred from Summit Lake in the Wrangell-St. Elias National Park.

-continued-

Lake	Species	Date	Number	FL (in)	FL (mm)	Lifestage
Summit Lake	AC	6/10/2004	5,247	8.5	215	C
Summit Lake	AC	8/21/2007	4,000	3.7	94	S
Summit Lake	AC	9/1/2009	5,999	3.4	86	S
Tex Smith Lake	RT	5/21/2004	455	8.5	215	C
Tex Smith Lake	RT	6/22/2004	413	8.3	211	C
Tex Smith Lake	RT	5/19/2005	500	8.2	209	C
Tex Smith Lake	RT	5/31/2006	250	10.1	257	C
Tex Smith Lake	RT	8/29/2007	5,000	2.2	55	F
Tex Smith Lake	RT	8/26/2009	3,000	2.0	50	F
Tolsona Lake	RT	7/2/2008	30,231	3.6	92	F
Weasel Lake	RT	8/2/2004	800	1.9	48	F
Weasel Lake	RT	8/14/2008	795	2.2	56	F

Species Codes:

RT	Rainbow Trout
SS	Coho Salmon
AC	Arctic Char
GR	Arctic Grayling
KS	Chinook Salmon

Lifestage Codes:

F	Fingerling
S	Subcatchable
C	Catchable
B	Broodstock

APPENDIX B

CAPTURE DATA FOR FISH POPULATIONS SAMPLED IN 2008–2010

Appendix B.–Capture data for fish populations sampled in 2008–2010.

Data File	Description
XXX[a]	Lake, gear type, location, soak time, depth, species, fish length, water temperature.

[a] Data files have been archived and are available from the Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services, 333 Raspberry Road, Anchorage 99518-1599.